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Conceptualizing the marine environment through the analysis of children's drawings

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2017

Agradecimentos

Talvez seja melhor começar estes agradecimentos recuando um pouco atrás no tempo, muito antes de ter pensado em trabalhar e escrever uma tese, e lembrando-me daqueles que ao longo do tempo me ensinaram a nunca desistir, a tentar ser mais e melhor, a ir mais longe e a agarrar as minhas convicções. Por mais turbulentas que fossem as viagens e sinuosos os caminhos, obrigada por me mostrarem que percursos mais fáceis não são necessariamente os melhores.

Hoje concluo mais uma etapa, etapa essa que não percorri sozinha. Aos meus Super-Amigos da licenciatura, porque a amizade dá outro sabor às coisas, um grande obrigada! A vocês, que enfrentaram comigo as dificuldades de ser estudante e de avançar para um mundo novo e diferente (e vamos ser realistas, por vezes assustador!). Não só tornaram o meu percurso mais fácil como fizeram com que eu vá ter muitas saudades das boas experiências que partilhámos, algo que vou guardar até ser velhinha ☺

Passando aos meus amigos de mestrado… bora fazer mais mestrados juntos?! E especialmente a vocês, os que me acompanharam e apoiaram nos últimos tempos, Catarina, Carol Caracol, Laurindinha, Joãozinho, podia escrever 100 vezes a palavra "obrigada" em caps lock que não iria bastar. Foi muito bom rir (e chorar) convosco. Estiveram sempre disponíveis para mim, mesmo quando nem para vocês próprios tinham tempo. Conquistaram um lugarzinho importante ☺

Às pessoas mais importantes da minha vida, as quais faço questão que fiquem registadas, quero que saibam que o meu esforço e empenho não é apenas a pensar em mim mas para vos deixar orgulhosos a vocês. Obrigada a ti Mãe, que és uma força da natureza que admiro, a ti Mana, e minha metade, a ti João, que foste e serás sempre o meu maior suporte. Um obrigada muito especial e obeso à minha irmã Ana, que por mais agitados que fossem os seus dias, garante sempre um espacinho para mim! Obrigada pai, avó, tio, e restantes manas, isto também é por vocês!

E finalmente, porque a ordem aqui não é intencional, obrigada ao Professor Henrique por ter aceite, sem hesitações, o convite para ser meu orientador (espero que nunca se tenha arrependido!), pela sua grande ajuda e profissionalismo (mesmo com a carga de trabalho que tem constantemente sobre os ombros) e espírito sempre positivo e carinhoso. E a si Cristina, pelo seu enorme perfeccionismo, por puxar sempre por mim e por ter acreditado no meu trabalho e me ter recebido de braços abertos assim que fui ter consigo para a escolha do projecto. Obrigada aos dois, que eu escolhi muito bem, e que possibilitaram a realização este trabalho!
Também não posso deixar de agradecer ao Ioannis, que desde o início se revelou muito prestável e entusiasmado com a minha participação neste trabalho.

E a todos os meus professores, com quem me cruzei durante a minha caminhada, que contribuíram não só para a minha formação enquanto aluna mas também enquanto pessoa. Todos participaram na construção de quem sou hoje e quem gostarei de ser no futuro.

Resumo

De entre os diversos problemas ambientais que caracterizam a idade contemporânea os do Oceano estão entre os mais preocupantes devido à diversidade e magnitude dos seus impactos. Na verdade estes problemas não são um inconveniente exclusivo dos organismos marinhos mas afectam sim, todas as formas de vida marinha e terrestre que dependem do oceano para a sua subsistência. Os presentes panoramas marinho e terrestre surgem como resultado das actividades humanas e apesar de todos os alertas que têm sido lançados para a consciencialização ambiental oceânica, os comportamentos humanos caminham, na maioria das vezes, numa direcção oposta a estes esforços. Uma vez que os comportamentos possuem uma dupla natureza racional e emocional, baseadas em percepções que levam a interpretações e, por sua vez, a intenções procurou-se clarificar a forma como era representado o oceano. Tendo em conta que o processo de aprendizagem e reconstrução de valores, atitudes e comportamentos exige tempo e trabalho, o foco nas gerações mais jovens é essencial. Para o efeito, no presente estudo, foram seleccionadas 6 escolas de três áreas distintas (Rural, Urbana Recente e Urbana Antiga, dentro de ou próximas de Lisboa). Através de uma visita presencial, foi pedido aos alunos do primeiro ciclo destas escolas que desenhassem aquilo que acreditavam existir no oceano, e as suas criações foram recolhidas e utilizadas como fonte de informação das percepções e conhecimentos prévios. Após um intervalo de aproximadamente duas semanas, 3 das escolas iniciais foram sujeitas a uma pequena sessão educativa sob o formato de PowerPoint e no mesmo dia, imediatamente após a sessão, foi pedido aos seus alunos que elaborassem novamente um desenho com base no mesmo enunciado da primeira visita e recolhidos os seus trabalhos. Esta segunda recolha efectuou-se tanto nas escolas que participaram na sessão, como também nas restantes. As 3 escolas que não assistiram a qualquer apresentação funcionaram como controlo para termos de comparação. A apresentação incidiu sobre dois tópicos essenciais, um natural e descritivo das características do oceano e de todos os seus atributos e um antropocêntrico, referente aos impactos a relação entre o Homem e o oceano. Com a análise dos desenhos correspondentes às duas visitas pretendeu-se averiguar o sucesso da transmissão e captação de conhecimentos, confirmado pela representação de novos elementos na segunda visita, e este sucesso mostrou-se evidente nas turmas submetidas à sessão educativa. Este trabalho detectou pequenas tendências em alguns dos elementos desenhados pelos géneros e registou também pequenas diferenças entre as áreas urbanas e rural. Dos temas abordados durante a apresentação, aquele cujo impacto nos desenhos das crianças registou maiores diferenças entre visitas foi o do lixo marinho. As crianças revelaram ter uma elevada sensibilidade para com os temas ambientais e comprovaram que abordagens visuais de causa-efeito produzem resultados imediatos numa fase precoce da idade.

Palavras-chave: Literacia sobre o Oceano, Consciencialização ambiental, Mares e oceanos, Desenhos, Percepções de crianças, Escolas.

Abstract

Among the various environmental problems that characterize the contemporary age, those concerning the ocean are among the most concerning due to the diversity and magnitude of its impacts. In fact, these problems are not only an inconvenience for marine organisms but they affect all forms of marine and terrestrial life that depend on the ocean for their subsistence. The present seascape and landscape emerges as a result of human activities, and despite all the warnings that have been raised for ocean environmental awareness, human behaviours are often towards the opposite direction of these efforts. Since the behaviours are under a dual rational and emotional nature, based on perceptions that lead to interpretations and intentions, it was sought to clarify the way the ocean was seen and represented. Since the process of learning and rebuilding values, attitudes, and behaviours takes time and work, a focus on the younger generation is essential. With this scope, in the present study, six schools of three distinct areas were selected (countryside, urban recent and urban old areas, within or nearby Lisbon). Through a in person visit, students in the first cycle of these schools were asked to draw what they believed existed in the ocean, and their creations were collected and used as a source of information on perceptions and previous knowledge. After an interval of approximately two weeks, 3 of the initial schools were subjected to a small educational session in PowerPoint format and on the same day, immediately after the session, their students were asked to produce a drawing based on the same principle from first visit and their work was collected. This second collection took place both in the schools participating in the session and in the others. The 3 schools that did not attend any presentation functioned as controls for terms of comparison. The presentation focused on two essential topics, a natural and descriptive of the characteristics of the ocean and all its attributes and an anthropocentric one, concerning the impacts of the relation between mankind and the ocean. The analysis of the drawings corresponding to the two visits was intended to verify the success of the transmission and knowledge retention, confirmed by the representation of new elements in the second visit, and this success was evident in the classes submitted to the training session. This work detected small trends in some elements drawn by the genders and also revealed small differences between urban and rural areas. Of the topics covered during the presentation, the one whose impact on children's drawings recorded the greatest differences between visits was marine litter. Children have shown a high sensitivity to environmental issues and have demonstrated that visual cause-and-effect approaches produce immediate results at an early age.

Keywords: Ocean literacy, Environmental awareness, Seas and oceans, Drawings, Children perceptions, Schools.

Resumo Alargado

Perante as frágeis circunstâncias ambientais que actualmente se fazem sentir é cada vez mais imperativo a mudança de uma sociedade (aparentemente) desligada, distante e conformada perante o meio natural para uma sociedade consciente, dedicada e participativa das questões ambientais.

A ambição por um futuro sustentável e dotado de oportunidades é, em grande parte, alcançável através da substituição de valores, reflexão e mudança de atitudes e harmonia de comportamentos, uma vez que anteriormente, alguns desses mesmos valores, atitudes e comportamentos contribuíram para as condições menos positivas que caracterizam a relação Homem-Ambiente nos dias de hoje. Porquê valores? Porque somos movidos pelas nossas crenças. Porquê atitudes? Porque para agir é necessário uma intenção. E porquê harmonia de comportamentos? Porque o meio ambiente é comum a todos e compete igualmente a todos trabalhar para o mesmo objectivo.

O interesse e preocupação pelas temáticas ambientais poderão ser mais facilmente incutidos após um conhecimento abrangente dos factos, e este conhecimento revela-se (muitas e demasiadas vezes) insuficiente. Matérias não tão visíveis e directas para a maioria das pessoas, como sejam as relativas ao ambiente, necessitam de ser exploradas e aprofundadas para incentivar ao estabelecimento de uma ligação entre o Homem e o meio que o rodeia.

Assim, a educação assume um papel preponderante na consolidação de uma cidadania ambiental assente na responsabilidade, respeito e consideração pelo nosso património natural. É fundamental que o Homem seja instruído acerca dos diferentes ecossistemas, informado de todas as suas características e ciente da sua importância e valor.

Este trabalho centra-se num dos maiores atributos da vida no Planeta: O Oceano. O Oceano é parte integrante da Natureza e participa em diversos processos, sendo o suporte de vida, não só das populações marinhas mas também da vida terrestre, bem como de desporto e lazer, por se tratar de um local destinado a práticas desportivas e radicais associadas ao ser humano, de transporte de pessoas e bens, contribuindo para a eliminação de barreiras geográficas e como estimulador da economia, enquanto gerador de emprego e meio atractivo da actividade marítimo-turística. Finalmente, numa vertente mais estética, emocional e simbólica, funciona igualmente como fonte de inspiração e de relaxamento.

Apesar de todos os atributos inerentes ao Oceano também este tem sido alvo de algumas negligências, com efeitos negativos e drásticos tanto para as populações marinhas que o integram como para o próprio ser humano que depende dele para a supressão das suas necessidades mais básicas. O aumento dos níveis de poluição resultante das actividades humanas conduziu a alterações climáticas, contribuindo para a acidificação dos oceanos e levando à alteração das suas condições originais e à destabilização dos comportamentos e migração das espécies. Este fenómeno facilitou ainda a invasão e proliferação de espécies indígenas adaptadas às novas condições e, consequentemente, ao declínio das espécies naturais confrontadas com a competição por alimento e espaço e à perda de biodiversidade e transformação completa da estrutura natural das cadeiras tróficas. No entanto o declínio das populações marinhas não se deve apenas às mudanças na composição das águas mas também a factores directos, nomeadamente à pressão exercida pela intensa actividade piscatória que não só captura intencionalmente organismos em quantidades excessivas como utiliza métodos de pesca destrutivos lesivos para espécies não-alvo, muitas vezes provocando mesmo a sua morte. Adicionalmente, também algumas actividades económicas como o transporte marítimo e o turismo participaram neste processo de degradação ambiental. O transporte marítimo é muitas vezes responsável por derrames de produtos contaminantes

como o petróleo que tem efeitos sobre a qualidade das águas e muitos prejudiciais para répteis, mamíferos e aves, e o turismo praticado de forma incontrolada e insustentável é, não só uma fonte de perturbação para as população locais, como também gerador de enormes quantidades de lixo para as praias.

Uma vez que os comportamentos humanos têm consequências desastrosas evidentes nos efeitos que se fazem sentir nos dias de hoje, é imperativo que esses mesmos comportamentos sejam abandonados e substituídos por hábitos mais correctos e favorecedores de um futuro saudável. No entanto, os comportamentos estão muitas vezes bastante enraizados nas pessoas e a sua alteração exige estratégias trabalhosas e esforços acrescidos.

O presente trabalho segue precisamente essa direcção mas actua a um nível ainda mais básico: o das percepções e conceptualizações, a partir das quais são construídas crenças e valores, onde assentam esses comportamentos. Essas concepções podem ser fundamentadas por conhecimentos correctos, incorrectos e insuficientes. Após a enumeração de todos os problemas associados ao meio marinho, constata-se que a escolha das acções humanas não tem obedecido às tentativas de mitigação dos impactos causados. Assim, será importante identificar onde existem eventuais falhas a nível dos seus conhecimentos e percepções, que impeçam a conjugação destas acções com a melhoria do estado do oceano. Este estudo recorreu à análise de desenhos com foco no meio marinho, de crianças no primeiro ciclo do ensino básico, enquanto fonte indicadora dos seus conhecimentos.

A escolha de crianças ao invés de adultos deve-se ao facto dos adultos já terem conceitos e convicções bastante vincados, resultado do conhecimento adquirido e das experiências a que foram sujeitos ao longo da vida. O factor "tempo" é uma condicionante importante e este exerce uma menor influência em idades mais precoces. Contudo, essas influências existem e ocorrem desde muito cedo e de forma inevitável durante o crescimento e até iniciarem o seu percurso escolar, não podendo ser ignoradas.

A recolha dos desenhos feitos pelas crianças decorreu ao longo de duas fases: A primeira que testou os conhecimentos prévios já adquiridos acerca do oceano, e a segunda que teve lugar após uma pequena formação sob o formato de PowerPoint em matéria oceânica que focou aspectos científicos associados à natureza dos oceanos e espécies que o compõem e aspectos sociais ligados à relação entre as práticas humanas e o oceano, com a introdução das problemáticas marinhas e de possíveis alternativas a essas práticas.

Os participantes submetidos ao teste pertenciam a escolas representativas de três áreas distintas, classificadas como 'Urbana Recente', 'Urbana Antiga' e 'Rural'. Destas três áreas foram amostradas duas escolas, sendo que uma delas foi tratada enquanto grupo de controlo. Ambas as sessões de recolha dos desenhos tiveram lugar nas salas de aula das respectivas turmas, sendo que a primeira teve a duração de uma hora e a segunda de hora e meia (meia hora para a apresentação PowerPoint e uma hora para a elaboração dos desenhos). Os elementos presentes nos desenhos foram registados e organizados em tabelas onde foram posteriormente associados a categorias. A partir destas tabelas foi realizada uma análise, procurando averiguar quais as categorias preferidas pelos alunos (antes e depois da acção de formação) e as eventuais influências mediante o género da criança ou área onde a escola estava inserida. Uma análise posterior efectuou uma comparação entre a primeira e a segunda visitas entre turmas de controlo e não-controlo, com o objectivo de detectar diferenças que reflectissem a aquisição de conhecimento durante a segunda sessão nas turmas de não-controlo.

A observação directa dos desenhos permitiu retirar algumas conclusões prévias ao nível da grande diversidade de elementos representados, da discrepância na complexidade dos desenhos relativos a alguns alunos e da concordância na escolha dos elementos, tendo-se revelado as algas marinhas o elemento mais comum na maioria dos desenhos. As análises realizadas ilustraram a existência de pequenas tendências na escolha de alguns elementos mais vezes associados a um dos sexos, assim como diferenças visíveis entre as áreas urbanas e a área rural, sendo que esta última reuniu uma maior percentagem de elementos humanos e míticos. A análise comparativa das turmas controlo e não-controlo relativamente à primeira e segunda sessão localizou diferenças após a apresentação PowerPoint, sendo essas diferenças particularmente evidentes em elementos mencionados durante a apresentação às escolas. O elemento que registou uma maior diferença na frequência de ocorrência entre sessões foi o lixo marinho. Verificou-se ainda que a segunda sessão realizada nas escolas provocou uma maior uniformização nos desenhos dos alunos relativamente aos elementos retractados, existindo uma maior orientação no sentido de alguns deles.

Conclui-se que a aquisição de conhecimento, de facto ocorreu, e que essa aquisição teve especialmente sucesso durante a transmissão de conhecimentos relativos à temática da poluição. Desta forma os alunos revelaram ser dotados de uma grande sensibilidade e sentido de responsabilidade e a abordagem utilizada eficaz na produção de resultados imediatos. A metodologia mostrou-se competente na recolha dos conhecimentos prévios e adquiridos pelos alunos e os resultados positivos para o objectivo último do trabalho: sensibilização e consciencialização ambiental.

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CHAPTER 1:
General Introduction

1.1. General Introduction

Oceans and seas occupy 70% of the Earth's surface (Irigoien *et al.*, 2004) and provide about 97% of water supply (Oceanic institute, 2017; NOOA, 2017). Oceans and seas are indispensable to the maintenance of life on the planet, play fundamental roles in the functioning of ecosystems and shape human communities, especially in coastal areas. Most people may not be aware that oceans and seas harbor the greatest biodiversity on Earth (Snelgrove, 1999), ranging from microscopic organisms to the largest known animal species (World Wildlife Fund, 2017d; National Geographic Society, 2017a). The lack of awareness and knowledge that some people reveal about marine environments is due to most of them having an occasional and mainly seasonal contact with it, seeing it as an activity.

Most of the population often interacts with coastal and marine environments exclusively for commercial, industrial and recreational purposes (Clark, 1992). Oceans and seas are often associated with beauty and vastness and its history is closely intermingled with human history and technical and economic developments across the globe (Canny & Morgan, 2011). Their value is usually underestimated mainly due to certain human limitations in assessing and observing it as a whole ecosystem, but marine environments are also places that envision prosperity and abundance as well as beauty (Roberts, 2007).

Marine environments perform several functions with its currents distributing heat and atmospheric gases across the globe and regulating Earth's climate (Reid *et al.*, 2009; National Geographic Society 2017a). Oceans and seas set in motion important hydrological and carbon cycles between the atmosphere, the physical environment and living organisms (Webster, 1994; Behrenfeld *et al.*, 2006). These cycles were of extreme importance to provide the favorable conditions to the emergence of life on the planet, and continue to be fundamental to maintain them. The ocean is a natural filter for the atmosphere, with phytoplankton absorbing large amounts of carbon dioxide, and in turn producing much of the oxygen available – 70% of the oxygen we breathe comes from the microscopic aquatic organisms with photosynthetic capabilities (Sekerci & Petrovskii, 2015; National Geographic Society, 2017b).
Oceans and seas should not be reduced to their chemical and physical properties. More than large reservoirs of water, they encompass large sets of ecosystems intimately shaped by their waters, ranging from surface coastal areas down to the - practically unexplored by humans - ocean floor (Jebbar, 2015). Deep seas and seabed form an extensive and complex system which communicates with the rest of the planet through the exchange of matter, energy and biodiversity. The functioning of deep-sea ecosystems is crucial for global biogeochemical cycles, on which depend not only marine organisms but much of terrestrial life, including human civilization (Danovaro *et al.*, 2016). Coastal areas play an essential role in general well-being and quality of life, providing recreational activities and psychological benefits (Fleming *et al.*, 2006; White *et al.*, 2010) as well as sheltering many marine organisms.

Along with tropical rain forests, oceans support the widest diversity of species on the planet (World Wildlife Fund, 2017a,b). Scientists estimate that this species-rich environment is home to 10 million species with 14 animal phyla (out of the total 35 existing) being exclusive to the marine environment (Gibb *et al.*, 2013). The richness of marine environments is intrinsically linked to their own diversity, presenting a set of very different conditions and habitats suitable for species with distinct requirements. Although easily overlooked, the highest points, deepest valleys and vastest plains on Earth are all located in oceans (Greely, 2008), and they are not as homogeneous as appear to be at first glance from the surface.

Moreover, considering an anthropocentric point of view, seas and oceans are used as means of transportation for people and goods, effectively stimulating trade and communications (Roberts, 2007). Globalization was first conducted via seas and oceans as early as the 15th century and still today these environments foster globalization and ensure a considerable part of the food requirements of human populations through fishing and aquaculture (Bolster, 2012). Living aquatic resources such as fish, mollusks and algae rank fifth as the world's largest resource after rice, forest products, milk and wheat, accounting for 7.5 percent of total world food production (Safran, 2009). Besides filling elementary nutritional needs, these habitats are also central to the health sector, providing resources to produce pharmaceuticals (Malve, 2016), as well as to the industrial sector, allowing the extraction of minerals and oil (Thurber *et al.*, 2013).

Until the nineteenth century, the vast depth and width of the ocean were attractive as they were perceived to mean virtually unlimited and inexhaustible resources (Gopnik, 2015), without any notion of the repercussions and impacts of its overexploitation. Although undoubtedly very large, the ocean is also finite and limited in resources, having gone through significant changes as a result of human action. While earlier human exploitation of marine resources focused mainly on small-scale fishing for survival purposes, more recent changes in marine environments (in temperature, pH, chemical composition, etc.) are to a large extent the accumulation of collective impacts of human behaviour and lifestyle in modern industrialized countries (Mckinley & Fletcher, 2010).

Throughout history, with population growth coupled with the advancement of industry and technologies, as well as of food availability, human intervention became successively more frequent and intensive, and its effects have been worsening and some of them are now irreversible. Despite the promising discourse about renewable energy sources in the last years, there is still strong insistence on the exacerbated use of polluting energy sources - fossil fuels - such as coal, oil and natural gas. Pollution levels continue to increase bringing consequences for the oceans that absorb the atmospheric gases - it is estimated that at least a third of the total amount of carbon dioxide from human activities has been absorbed by the oceans since the 19th century, as well as about half of the emissions resulting from burning fossil fuels (Sabine, 2004).

The emissions contributed to the acidification of the oceans, leading to the transformation of their original conditions and the destabilization of the processes and behaviours of the species (Orr *et al.*, 2005; Kuffner *et al.*, 2007; Langdon, 2005). The invasion and proliferation of non-indigenous species, usually better adapted to the new conditions, benefit from the decline of the indigenous species often caused by competition for food and space with these new species (Naylor, 2001). Some species die and others migrate resulting in a loss of biodiversity and a complete transformation of the natural structure of the food chain (Byers, 2002; Occhipinti-Ambrogi & Savini, 2003). This is also critical for humans since biodiversity provides important ecosystem services – like jobs and food supply (Marchese, 2015). However, the decline in marine populations is not only due to changes in water composition but also to direct factors, in particular the pressure of intense fishing activity, which not only intentionally captures organisms in excessive amounts but uses destructive fishing methods as well, harmful to non-target species, often causing their death (Hall *et al.*, 2000). Some species are now extinct and others in the process of becoming so, as they are captured at a much faster rate than they can be naturally restored. According to non-governmental organization Greenpeace, 63 percent of global fish populations are characterized as overfishing, for example, an increasing number of sharks and rays appear on the IUCN Red List of Threatened Species every year. In terms of social and economic impacts for society, 40 000 jobs were lost with the collapse of only one population of overfished cod (Greenpeace International, 2016).

In addition, some activities such as shipping and tourism have also participated in this process of environmental degradation. Shipping contributes to the pollution of the oceans in several ways. This pollution can be chemical, generated by the loading and unloading of materials such as oil and other chemicals (accidental spills are frequent) and deliberate dumping of garbage from boats; it can also be biological - by the transport of invasive species that settle in ship hulls or infiltrate ballast waters; and not less important: physical pollution, through the launching of anchors, disturbances caused by the noise and agitation of the waters (World Wildlife Fund, 2017c; European Environment Agency, 2016). Beyond this, tourism and coastal occupation have negatively affected the coastal areas, which only accounts for 10% of the marine environment but it is home to more than 90% of all marine species – generating huge amounts of waste in beaches. These areas are the most popular holiday destinations in Europe - 63% of European tourists choose coastal areas for their vacations (Kubo, 2004) – and more than a half of the human population lives within 50 km of the coastline (Pereira *et al.*, 2007; Mckinley & Fletcher, 2010; Boersma & Parrish, 1999), with the majority concentrated in urban areas along the coast. In 2001, 70 million people (14% of EU's total population) lived within 500 meters of the coast (European Environment Agency, 2016).

Marine environmental problems are frequently reported in the media, so several people may be well informed about them. Nevertheless, many of these problems continue to exist and it is observed that individual behaviours do not always intend to improve them (Félonneau & Becker, 2008). It is possible to arrive at several interpretations from this incoherence of behaviours: they happen because there is no access to information or the information arrives but it is not deciphered, because these problems are not perceived as a common responsibility, because there is a feeling of impotence to solve the problems presented, or simply due to lack of interest in the subject. Actually, there is some sense of futility in humans that makes them doubt about how their way of acting interferes with what happens in the ocean and that behavioural changes are useless (Fletcher & Potts, 2007). The fact that the information is not accessible to the public, is not comprehensible or is not valued, has the same result and can be mitigated with the help of citizen education.

If the improvement of the circumstances that are felt nowadays, and which will be felt in the future of subsequent generations, highly depends on a change in people's routines and patterns of behaviour, it is paramount that we start by ensuring that environmental awareness reaches as many people as possible as soon as possible. Since education is a long and time-consuming process, and it occurs daily in different contexts and under different influences (Sorin & Gordon, 2012), many of which can not be controlled, it is imperative to start it at an early stage of life. A building needs a good foundation to sustain it to not collapse, and this foundation is the first thing to be built. Knowledge must follow the same logic: from the bottom to the top, from children to adults.

Thus, it is identified one of the foundations on which it is necessary to invest: education. Education can be achieved by different learning methods: formal education (obeying a structure, usually taking place in educational institutions), non-formal education (mediated by characteristics of formal education but where the motivation to learn must be totally intrinsic to the student, in institutions outside the school nucleus) or informal education (which can arise anywhere, in spontaneous situations, without any authority, figure or mediator) (Eshach, 2007).
Some advocate that education that occurs outside the school environment is quite effective as it stimulates interest, understanding, and commitment to future learning (Gardner, 1991), and while some critics question whether these environments actually work in the assimilation of contents, and are not

just entertainment, others respond that entertainment works in capturing knowledge (Rennie & McClafferty, 1996).

In this context: Is an entertaining education method convincing enough to make citizens follow a different set of behaviours? Is it enough to add content to people's repertoire of knowledge? Using a very simple example: A box that is full does not have room to pack more stuff. However, a not so full box but with sharp objects makes it difficult to add incompatible objects like balloons. This can be compared to the human brain and the process of knowledge transfer. The full box represents most adults and the box with sharp objects can represent both children and some adults. The transfer of new knowledge to adults is already difficult given the convictions deeply rooted that have been instilled over the years. However, also in children with little experience where the knowledge and beliefs are not fully formed, the acquisition of correct and new knowledge (balloons) may conflict with the acceptance of prior knowledge (sharp objects), and the two cannot exist together. Thus, a new scope is identified on which investment is also necessary: perceptions, conceptions and representations, because the way people see, believe and feel things and the meaning they attribute to them is important to realize the choice of behaviours (Gómez, 2012).

Human perceptions are rarely homogeneous and are conditioned by variables such as age, gender, social values, or proximity to the coast (Russonelo *et al.*, 1999; Rose *et al.*, 2008; Jefferson *et al.*, 2015). Over time human perceptions of the marine environment have been changing. Retreating only 150 years ago, until the early modern age, the ocean was especially known to travellers and explorers who told stories about monstrous and exotic creatures inhabiting the seas, where the ocean symbolized fear and mystery (Brito, 2016). In the book "*Fictions of the Sea - Critical Perspectives on the Ocean in British Literature and Culture*" Klein (2002) makes the following distinction between the periods: "*The negative image of the evil sea and its many associated dangers is traditionally seen to be replaced in the 18th century with an emerging conception of the ocean - in the contexts of colonization, economic modernization and global trade - as technically manageable but socially sensitive space (...) and contemporary nautical drama foregrounds realistic elements of life and work at sea. The romantic counter-image world re-invest the sea as a realm of unspoiled nature and refuge from the perceived threats of civilization.*"

Moving on to the contemporary age, the development of technology and the inherent curiosity of the ocean has led to its increasing exploration and use as a source of resources and leisure. By now, is possible to understand that the ocean is seen in different ways, by different people, at different times, under different contexts and that the way people see it dictates the way they use it. However, there are few studies to assess public perception of the marine environment (Rose *et al.*, 2008; Williams, 2008), with most being conducted in United States of America (USA) and including investigations of children (Cummins & Snively, 2000), adolescents (Nordstrom & Mitteager, 2001; Plankis & Marrero, 2010) and adults (Steel *et al.*, 2005).

The decision to move forward with this project was based precisely on the various parameters that have just been discussed above. Firstly, the ocean is increasingly a cause for concern given the adversities it faces from various directions and the importance it has for the subsistence of the human beings and all other forms of life, making necessary, and urgent, its protection. Second, virtually all of the problems identified are the result of human actions, and the conclusion is that instead of correcting the damage that has been caused, it is of prime importance that the source of such damage be corrected first. In other words, before correcting the ocean, it is mandatory to correct humankind. Correcting humanity means changing the established habits and behaviours, that is, educating it. So, in the third place, it is important that time is devoted to re-educating citizens to abandon practices harmful to the ocean.

However, it has already been mentioned that this change cannot be achieved only through the supply of knowledge and must first start from the understanding of the basis of these behaviours, where their perceptions and representations reside, being the fourth motivation for this work. Finally, the studies that have been carried out so far have been directed to countries other than Portugal, so it is also interesting to gather examples from this country and also for children, since it has been commented previously that this education should start in the younger ones, who are the future of society and nature.

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CHAPTER 2:

Conceptualizing the marine environment through the analysis of children's drawings

2.1. Introduction

The oceans are Earth's largest ecosystem and one of the major sources responsible for our fundamental needs: air to breathe, water to drink, food to consume, new medicines, a climate that allows the existence of life, beauty, inspiration and recreation (Marine Conservation Institute, 2017); and to preserve history, culture and the traditions of various countries (Grilo *et al.*, 2017). Although the value of the oceans has been increasingly recognized, behaviours that neglect this same value continue to be practiced, bringing negative consequences for its proper functioning and for the survival of all the species that depend on it, including humans. Pollution, climate change, acidification, destruction/alteration of habitats, introduction of exotic species, intensive fishing and overexploitation or resources, destructive practices and uncontrolled tourism are some of the problems that have caused profound changes in marine ecosystems, resulting in its environmental degradation (Halpern *et al.*, 2008).

Attempting to curb this scenario, environmental associations and movements were consolidated in several parts of the world, contributing to the dissemination of ecological awareness, which has since become increasingly more consistent in the search for socially and environmentally sound behaviours (Reigada & Reis, 2004). At present, there are assorted pro-environmental groups and organizations (with or without partnerships) devoted to raising awareness and concern, using different approaches to get citizens involved, to reduce negative human impacts and encourage behaviours considered friendly to the environment. Some organizations coordinate programs focusing specifically on marine environments, and in the development of environmental education projects. Recently, the United Nations Educational, Scientific and Cultural Organization, and specifically the Intergovernmental Oceanographic Commission, has developed the "*One Planet, One Ocean*" project with the aim of disseminating scientific knowledge about nature and oceanic resources and coastal areas (UNESCO, 2017); and specifically, in Portugal, some entities have also developed work in ocean literacy. Several research centres developed programs on Ocean Literacy, mainly directed to young people and schools. The Calouste Gulbenkian Foundation launched in 2003 the *"Gulbenkian Oceans Initiative"*, aiming to promote the scientific knowledge and public and political perception of the benefits of marine and coastal ecosystems (Calouste Gulbenkian Foundation, 2017). Also, the Blue Ocean Foundation acts on the knowledge, preservation and sustained use of the ocean, also investing in educational programs aimed at the school public (Blue Ocean Foundation, 2017). The success of these organizations, although developed locally, already had a wider impact.

It is known that diverse ideas have been put into practice and that various social efforts, both nationally and internationally, have been made in order to capture public's attention and awaken its sense of perception to what is happening in the oceans. However, it is necessary to realize in advance the state in which these perceptions are found, whether these perceptions are right or wrong and, if not correct, receptive to the acquisition of new perceptions provided by the current environmental marine education strategies. This is a priority since the initial understandings affect the construction of new individual meanings (Bowker, 2007). Human environmental perception has been the subject of numerous studies. In fact, since the 1970s, these analyses have been considered crucial for understanding the relationship between man and the environment and for understanding how this relationship has been dealt with (Whyte 1977).

The perception of environmental themes has already been tested according to sociological approaches, whose target audience varied from children to adults. An example, is the work done regarding marine matter, mainly developed using questionnaires, reports and interviews with interest groups on different topics (Bearzi *et al.*, 2010; Turvey *et al.*, 2010; Maynou *et al.*, 2011; Engel *et al.*, 2014). Stakeholder

interviews, *i.e.* people who are in some way involved and who are affected by certain decisions or restrictions, directly, such as fishermen and tourists, prove to be useful sources of information but not very suitable regarding the reliability of the sample due to the possibility of skewed responses based on stereotyped interests and points of view (Engel *et al.*, 2014). Investigations focusing on human perceptions, whose target audience included adolescents and / or adults, were not the most reliable as unbiased sources of information or as receptive to new knowledge. Older people are likely to be influenced by previous education, experiences and by social representations and to potentially include prejudices in their interpretations and beliefs (Alerby, 2000; Cherney *et al.*, 2006; Jefferson *et al.*, 2014). Over time, experience of the world brings about higher cognizance about environmental issues, forming more knowledgeable individuals (Özsoy, 2012). At the same time, awareness can lead to more apprehension and frustration, fueling pessimism about the future (Barraza, 1999; Alerby, 2000; Engel *et al.*, 2014), and this can make the process of transmitting knowledge and adopting new attitudes and behaviors more difficult. By the contrary, younger people have had little experience of the world and are therefore closer to a condition of "blank slate". Their environmental conceptualizations are thus especially incipient, with little influence from school learning or other sources of information, such as media (Sorin & Gordon, 2012). Even children between the ages of 7 and 11, according to Anderson and Moss (1993), develop learned responses based on stereotyped images common in literature and media. Early ages experience the world in a more immediate fashion (in the "here and now") (Alerby, 2000) and research has concluded that positive environmental attitudes are developed at some time during early and middle childhood (White, 2004). However, the way young people's perceptions are assessed has to be different from how they are assessed in older people, since both expressed differently.

Children's stories cannot be relied upon to accurately portray what they know, and some studies have recommended approaches more adequate to these ages. Adults' knowledge on a particular subject can be probed through posing questions. However, this approach will have limited efficacy when directed at children, for example, in the of age of 6 or 7, as they lack the appropriate vocabulary for explaining their ideas and can moreover feel uncomfortable when subjected to questioning (Farokhi & Hashemi, 2011; Özsoy, 2012). Conversely, children often enjoy drawing without showing signs of tension (Barraza, 1999; Farokhi & Hashemi, 2011).

Drawings have been used for years as tools to access young people's minds (Aronsson & Andresson, 1996; Guichard, 1995; Tunnicliffe & Reiss, 1999). Many researchers report that much of children's perceptions and attitudes about the environment can be revealed through drawings (Alerby, 2000). Another important aspect of this method, according to Chambers (1983), is that drawing is able to overcome language barriers between children of different nationalities, and can therefore serve as a universal communication tool. Some authors (Cherney *et al.*, 2006) also suggested that children should be subjected to this approach as early in life as possible (provided they already possess the necessary skills) since over time children come to draw the world more as it is culturally represented, than as it is directly perceived by them. Children's perceptions and attitudes are the key to how good or bad they interact with the future environment (Ewert *et al.*, 2005), and education is paramount for the building of awareness, concern and responsibility regarding the environment (Alerby, 2000; Cruz, 2007) and particularly, in this case, the ocean (Özsoy, 2012; Ananda, 2007). Awareness and knowledge resulting from education are key requirements for changing attitudes and behaviours, and thus to provide solutions to the environmental problems faced today (Özsoy, 2012; Mckinley & Fletcher, 2010).

This study, although based on environmental motivations associated with interest and concern for the ocean, is an interdisciplinary study that acts on a sociological level, aspiring to access the human ideas to understand the level at which the ocean, and everything related, is perceived as well as intervene on

these perceptions by making them closer to reality; and uses artistic approaches to access representations of perceptions and knowledge. This investigation was directed to a younger audience: young in the age and in the way of seeing and interpreting the world, being more flexible in the assimilation of information.

It intended to assess students' level of knowledge: (1) at the global level, exploring differences in particular criteria, such as complexity of details, diversity, number and type of elements; (2) at a temporal level under a "*Before and After*" analysis:

Before - Prior marine knowledge and intrinsic to the students;

After - Marine knowledge acquired after an educational session, which focus on different themes, administered to some of the students; and finally, the comparison of the results of the two evaluations and the detection (if some) of differences in the chosen themes represented in drawings that capture their attention the most.

This project is part of a wider international project related to the current perception of people about the marine environment and it is also integrated in European Action COST OPP - Oceans Past Platform (https://www.tcd.ie/history/opp/). This investigation has been applied in several countries, namely Greece and South Africa, and the same approach used for the oceans is pioneer in Portugal. The data, as well as being of great value for the understanding of children's perceptions about the marine environment, will serve as objects of comparison between countries and the success of these actions will be evaluated, based on the differences found. The ultimate goal of this study was to make children citizens more aware about the reality, more receptive to decision-making that may be imposed in the future, and ultimately endowed with more tools for environmentally sound behaviours.

2.2. Material and methods

2.2.1. Study design

This study was conducted with children attending primary school (1st and 2nd grades) between 5 and 7 years old. Schools were selected from two types of areas: countryside and urban area. The latter was subdivided into two distinct categories, old urban area and recent urban area, based on construction dates and general state of urban preservation of the school, but especially taking into consideration the neighborhood where they were integrated. Through previous contact with schools and the confirmation of their respective teachers, it was stated that none of them had participated in any project related to the sea, recycling being the matter closest to environmental issues they had been exposed to.

The study sample consisted in a total of 6 schools belonging to Lisbon's region which replied affirmatively to the request and fulfilled study requirements. Two schools were chosen for each area, and one class was selected for each school.
After the school and class selection process, school visits were arranged with the purpose of collecting the drawings that form the basis of this study, and to assess knowledge of marine environment. School visits took place in two stages: (i) a first visit, to test children's prior knowledge about the marine environment and (ii) a second visit, in which children attended a session on the topic to consolidate, and in some cases to correct, previous knowledge. These visits occurred between Jannuary and March 2017, when authorized by school administration.

i. Previous knowledge – First collection of drawings

In the first visit to the schools, students were explained the purpose of the study and how they could contribute to it; and they were asked to make a drawing that reflected what they expected to find while diving in the sea. Students were provided with an A4 sheet of white paper and pencils (for those who needed it). Although pencils were provided, students were advised to choose any coloring material they fancied and given the freedom to choose page orientation for their drawings. According to (Drew & Rankin, 2004), the availability of open-ended materials fosters freedom and autonomy of choice, both required for stimulating genuine creativity. This task took about one hour (each class having its own rhythm and pace). During this session students constantly asked what they could draw (providing examples), which colors they should use for each drawn element and what these were called. They were told they could draw anything they believed existed under water and represent it in their own personal way. After they finished the task, drawings were collected, and the child's age and gender written on the back of the sheet. Finally, authors were asked to identify the elements present in their creations to ensure that the interpretation and meaning were those attributed by the authors themselves (Benson, 2009; Bowker 2007).

ii. Acquired knowledge – Second collection of drawings

In the second visit, students were given a basic training session, by means of a PowerPoint presentation, which addressed different topics related to the sea. This presentation took around 30 minutes. The slides incorporated two distinct approaches: a) one focused on natural marine environments and their attributes, different marine ecosystems (ranging from shallow waters to the seabed) and their associated organisms, emphasizing the notion of biodiversity; and b) an anthropocentric perspective, focusing on the relationship of dependence between humans and the ocean, and the diversity of impacts resulting from human activities – namely beach tourism and coastal occupation, fishing, maritime transport, oil extraction and all major sources of marine pollution derived from these activities.

The training session aimed to: (1) capture children's curiosity and enthusiasm about the characteristics of the ocean and establish a connection between humans and the ocean; and (2) alert children to the different problems facing marine environments, and their threat to some of the seducing qualities of these environments, underlining the human causality of these problems and therefore also the possibility of human-led solutions. As means of conclusion, measures were suggested to mitigate these problems, namely: renewable energy sources, aquaculture, precautionary measures regarding waste disposal – with a view to inspire positive attitudes and behaviours in the students.

Classes were then instructed to make a second drawing to be compared with the first. Three control groups were established, each representing the area they belonged to (the initial intention was to divide the classes into two parts and one of the halves to function as a control, however for obvious reasons this would be impractical). Control classes were told to make their second drawing before the PowerPoint presentation, to avoid any influence from it. Non-control classes made the drawing after the presentation, to assess the influence of the session in children's representations. This task took about 60 minutes. As in the first task, students were asked to identify what they had drawn to avoid bias in data interpretation, while some children with writing skills had already done so during the practical exercise without prompting. Although the training only lasted for 30 minutes, analysis supported the idea that "children can and do learn an enormous quantity of information in a short span of time" (Goodnow, 1977).

2.2.2. Data analysis

Data was organized in a spreadsheet with general information on school area, drawing number and child gender. Elements of the marine environment within each drawing (*e.g.* whale, shell, jellyfish) were recorded and graphs were produced. However, the graphs were based only on a binary code of 0 for the absence of the element and 1 for the presence of the element, in order to focus on the diversity of elements and to avoid overestimation of the most common ones. This proceeding was applied to drawings resulting from both school visits, resulting in two distinct spreadsheets with 88 distinct elements (and so 88 lines) - See annex 1.

As soon as all the drawings from both visits were collected, another spreadsheet was built to organize the 88 elements which belonged to four overarching categories: a) "Marine Elements", including all living organisms and geological components (such as sand and stones) belonging to the sea and present in several drawings; b) "Elements of human intervention", which referred to all elements somehow connected with humans and their actions; c) "Mythical Elements", which encompassed all beings considered fictitious (such as mermaids and marine monsters) as well as their associated objects (e.g. tridents, castles); d) and lastly "Others", bringing together elements not belonging to either (such as land animals). Each of these four encompassing categories was moreover divided, resulting in a total of 26 sub-categories of elements, in order to reduce the original 88 elements but distinguishing and highlighting groups of more dominant and less dominant elements: *Whales and Dolphins*; *Other cetaceans*; *Sea lions and Seals*; *Sharks*; *Other elasmobranches*; *Squids and Octopi*; *Other mollusks*; *Jellyfish*; *Other cnidarians*; *Reptiles*; *Crabs, Lobsters and Shrimps*; *Other crustaceans*; *Common commercial fish*; *Other fish*; *Seahorses*; *Eels and Morays*; *Starfish and Sea urchins*; *Seabirds*; *Depth creatures*; *Phyto and Zooplankton*; *Seaweeds, Stones and Sand*; *Man*; *Boats, Baits and Fishing nets*; *Trash*; *Other social elements* and *Mermaids, Castles and Associated objects*. Although there are sub-categories of animals that share the same phylum, they are separated in some cases (e.g., Whales and

Dolphins / Other Cetaceans) in order to distinguish and highlight in a specific and more restricted way more frequent elements to the detriment of others, which appear more rarely in the drawings and are more broadly designated, preceded by the word "Other." Nine of these sub-categories belonging to (1) Marine Elements and (2) Elements of Human Intervention, were chosen to be introduced in the training, namely: (1) "*Other crustaceans*" - represented by barnacles, sea slaters and sand hoppers, "*Phyto and Zooplankton*", "*Depth creatures*" - represented by several deep sea organisms, "*Common commercial fish*" - represented by fish that humans usually consume; "*Other cnidarians*" – represented by the beadlet anemone, "*Seabirds*" - represented by pelicans, seagulls and penguins, "*Starfish and sea urchins*"; (2) "*Trash*" and "*Boats, baits and fishing nets*". The categories were chosen according to two different criteria: Elements considered as less known among the students (in the case of Marine Elements), with the aim to generate more knowledge about the ocean; and human subjects as a way of introducing oceanic environmental impacts with anthropic origin (in the case of Elements of Human Intervention).

Statistical test procedures were used to compare (1) the number of total items per drawing, (2) the number of different items, (3) the number of items relative to human intervention in the Ocean, (4) the number of mythical elements, and (5) the number of other items outside the study context, according to gender and to type of school (i.e. old urban area, recent urban area and countryside). Due to lack of normality and homogeneity of variances of data, non-parametrical test procedures were used (i.e. Mann-Whitney and Kruskal-Wallis testes, respectively for gender and type of school). These tests were applied to data relative to the first visit, since the second one was (partially influenced) by the training session.

In order to evaluate the impact of the training session on drawings and to ascertain the existence or not of patterns, according to session's number and type of school, principal components analyses were performed. Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. A first set of PCA were conducted with all the main categories of items identified in drawings, for each type of school. Also, a second set of PCA were performed analyzing only the elements addressed in the training session.

All the statistical analyses were performed using R software (R Development Core Team, 2008) and a 0.05 significance level was considered in all test procedures.

2.3. Results

2.3.1. Overall assessment

A total of 153 drawings were collected (306 in the sum of the two visits), each drawing corresponding to one children. The first evaluation focused on a qualitative and comparative overview of some aspects among students' drawings: richness and complexity, diversity of elements and existence of quantitative (number of elements) and qualitative (predominance and scarcity of elements) patterns.

The first aspect of evaluation was based on the amount of different elements found, regardless of their frequency, and a total of 88 different elements were counted (see Annex I). Thus, despite not existing an oriented criteria, the drawings of the children were considered diverse (a sample of drawings is presented in Annex II).

Considering both visits and across the three areas, the total average number of elements per drawing was 15. The number of elements recorded in each drawing practically didn't change, either between areas (except in the case of countryside where generally student's drew more elements) or between visits, almost obeying to a pattern. According to children's age and available sheet area for drawing, it was considered that the drawings of the students showed, on average, quite a lot of richness.

Regarding the frequency of some elements, *Seaweed* was the most common element in the global sample of drawings. Despite that, it wasn't always the main element in both genders with girls drawing seaweeds more often when compared to boys. There is no single element that can be considered the rarest, rather there are several elements with low representativeness, being present in only a few drawings.

The drawings reflected different levels of complexity, ranging from very rudimentary and traditional works (with almost imperceptible shapes and incomplete lines), some of them not even focusing on the marine context, to very elaborate and abstract works. However, most drawings did not reveal a rich repertoire of components, belonging to the first group of simpler and more primary representations. Only a few students exhibited drawings with higher levels of detail (see Annex II).

2.3.2. First school visits: *Previous knowledge*

A total of 66 drawings were collected from two schools in the **Recent Urban Area** (Figure 2.1). *Seaweed* was observed to be the most prominent element, followed by octopi, men, turtles, sharks, sand, dolphins and starfish, all presenting occurrence frequencies between 40% and 70%. The remaining elements featured less than 30% in children's drawings, with squids, rays, mermaids and anglerfish being the least represented elements among the twenty more drawn (≈ 13%).
There are some differences in the repertoire of elements between the two genders. Although *Seaweed* is dominant in absolute terms, in the case of boys the most frequent element was *Man*. Sharks, jellyfish, eels and rays appeared much more often in the boys' drawings and mermaids were best represented by the drawings of the girls. On the other hand the element *Squid* was exclusively drawn by the boys.

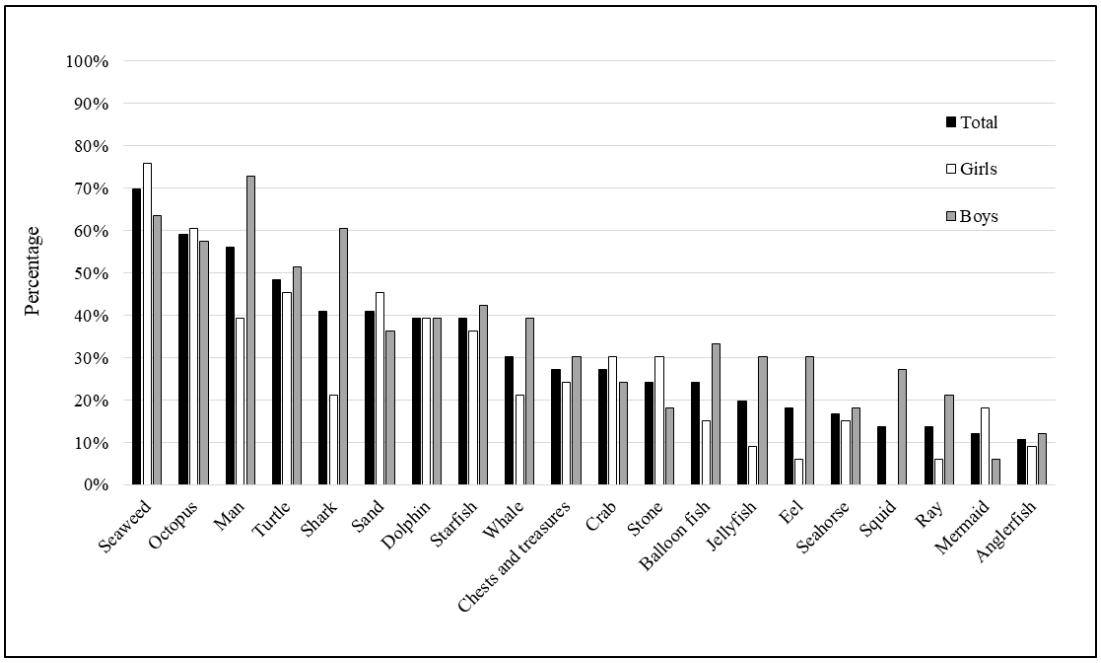

Figure 2.1: The 20 most drawn elements (highest frequency) of the Recent Urban Area, in the first visit to schools, by the total number of students (black bar), and the total number of boys (grey bar) and girls (white bar) - values relative to percentage of drawings that presented each element.

The **Old Urban Area** comprised two schools, making up a total of 38 students (Figure 2.2). Similarly to the Recent Urban Area, among these classes the most predominant element was *Seaweed*. Other most frequently drawn elements were, in descending order: octopi, dolphins, starfish, whales and sharks. Among the 20 elements exhibited in this bar chart, those with a smaller percentage of students' drawings (approximately 10%) were *Squid* - common to the Recent Urban Area -, and *Sea Urchin*, *Eel* and *Chests and Treasures* - differently from the Recent Urban Area.

Although *Seaweed* was the most drawn in proportion to the total number of students, between genders it ranked 2nd among the 20 most represented for both boys and girls. Regarding the female gender, the favourite element was *Starfish* (drawn by less than 20% of the boys) instead of the male gender which opted for *Dolphin* in most of its drawings (drawn by little more than 30% of girls). Other elements that still appeared in a high percentage of drawings were *Octopus* and *Whale* (registering similar frequencies for both genders); *Shark* and *Man* - mostly in boys -; and *Stone* - mostly in girls. On the underrepresented elements (less than 20%), only the girls drew balloon fish and clownfish and even seahorses were much more present in the drawings of girls.

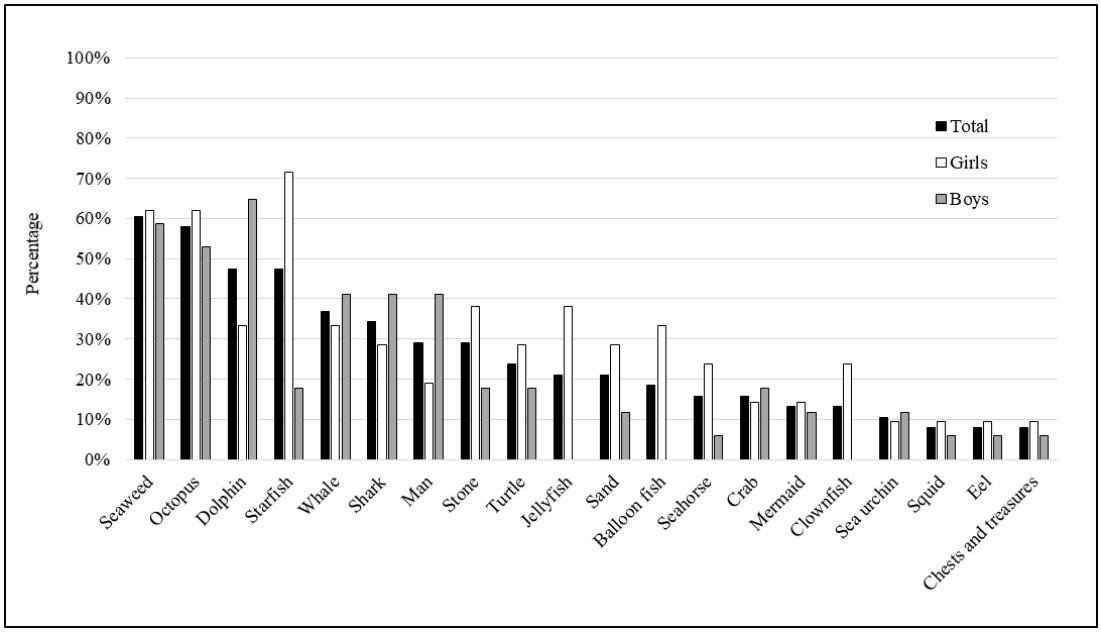

Figure 2.2: The 20 most drawn elements (highest frequency) of the Old Urban Area, in the first visit to schools, by the total number of students (black bar), and the total number of boys (grey bar) and girls (white bar) - values relative to percentage of drawings that presented each element.

In the **Countryside** 49 drawings were collected from two schools (Figure 2.3). In this case, the most represented element, disregarding genders, was *Starfish*. Other most frequently drawn elements included many of the same: men, seaweeds, octopi, stones, dolphins, sand, and sharks. However, in this area there is a greater standardization of the elements found in the students' drawings, presenting higher frequencies compared with the previous areas. Hereupon, elements that previously appeared at lower frequencies or never appeared before, now appear in percentages between 25% and 40%, namely *Chests and treasures* (it was the least represented element in OUA), *Boat* (had never appeared in the most frequent), *Seahorse* (which usually appears among the less frequent – less than 20%) and *Mermaid* (one of the least represented elements in RUA). *Squid* and *Anglerfish*, as usual, belong to the less frequent range, along with a new element present among the drawings: *Swordfish*.

Girls are the ones who contribute most to make *Starfish* the most popular element among students, occurring in 70% of their artistic creations. The element presented in most of the boys' drawings was *Man* (more than 70%) Regarding the other elements, their distribution by the drawings was very similar in the two genders: the most frequent elements were practically the same, varying only in the respective associated percentages. Some of the most visible exceptions were elements such as *Boat*, drawn twice as frequently in boys' drawings when compared to the percentage found in girls' drawings; the *Dolphin*, appearing in 50% of the girls' drawings and 30% of the boys; the elements *Mermaid* and *Whale*, represented by girls in a frequency three times higher than the frequency associated with male gender; and the elements *Balloon fish* and *Seahorse* drawn by twice the girls compared to the boys. As mentioned earlier, in this area there is a greater standardization between boys and girls and there is no element drawn by only one gender.

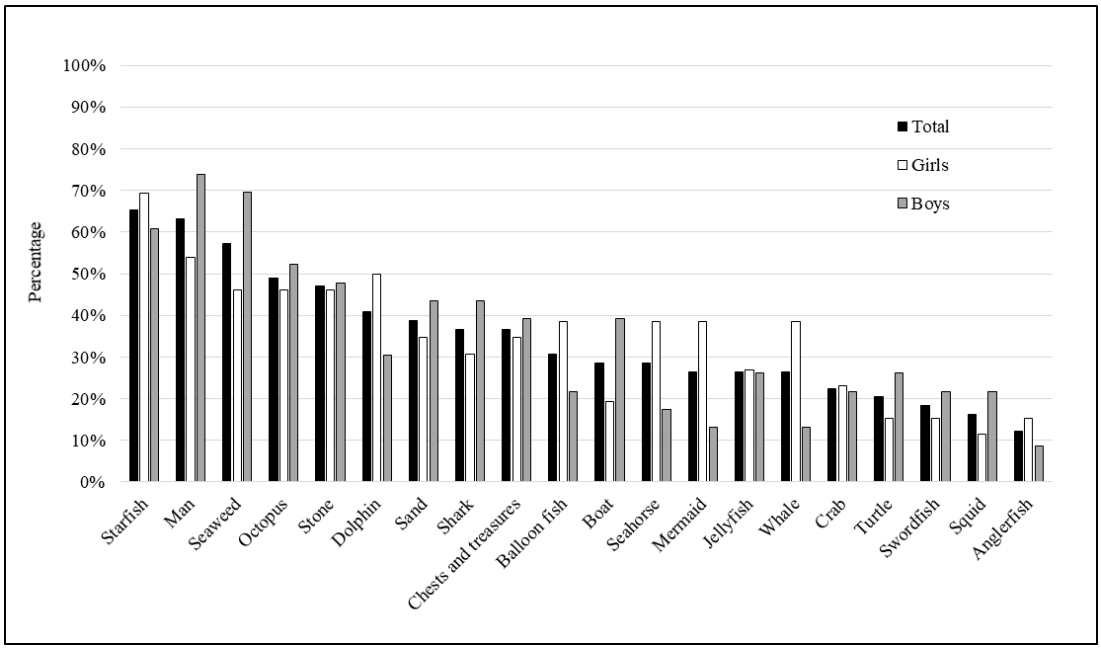

Figure 2.3: The 20 most drawn elements (highest frequency) of the Countryside, in the first visit to schools, by the total number of students (black bar), and the total number of boys (grey bar) and girls (white bar) - values relative to percentage of drawings that presented each element.

Considering all schools aggregated (Figure 2.4), *Marine elements* was the most represented category in the drawing sample, totalling 83% of elements drawn across all three school areas. *Elements of Human Intervention* made up a small percentage of 10%, while *Mythical elements* (fantastic creatures) added up to merely 7%.

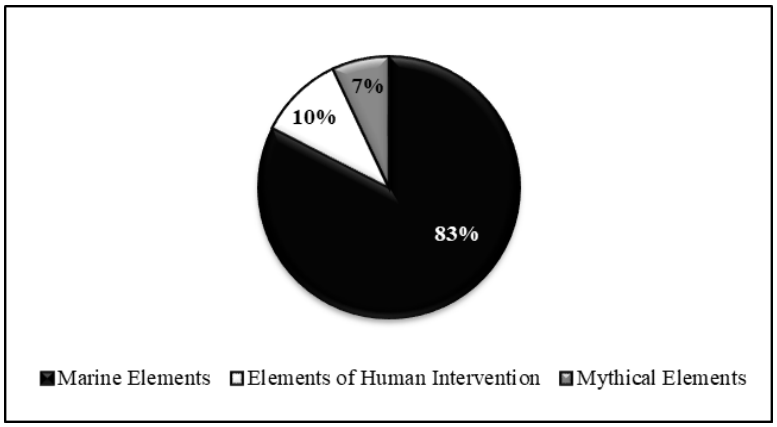

Figure 2.4: Frequency of elements drawn at the first visit to schools, according to the higher categories - Marine Elements (black portion - 83%), Elements of Human Intervention (white portion - 10%) and Mythical Elements (grey portion - 7%).

Through an additional graph (Figure 2.5) it can be seen that *Marine Elements* were drawn almost in the totality of the drawings of the first visit (99%), while the *Elements of Human Intervention* appeared in 82% of the drawings and *Mythical Elements*, in a percentage substantially smaller than the others, 75%.

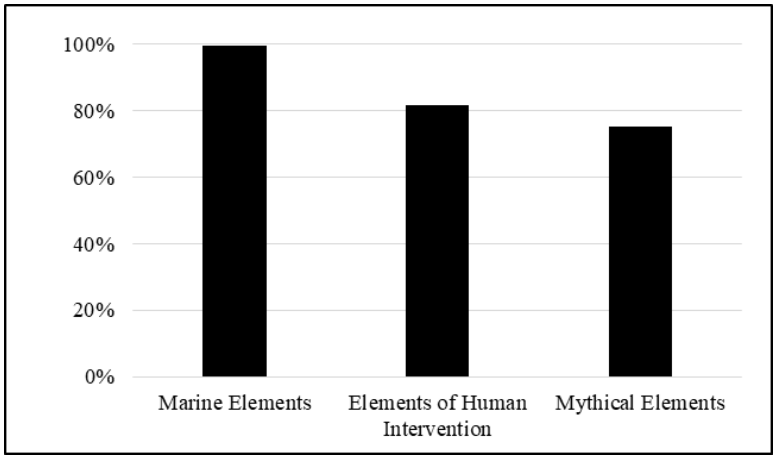

Figure 2.5: Occurrence frequency of the three main categories in the student drawings (percentage of students drawing these categories) of the first visit to schools: Marine Elements (99%), Elements of Human Intervention (81%) and Mythical Elements (75%).

The results of the Mann-Whitney tests comparing several attributes of the drawings, i.e. (1) the number of total items per drawing, (2) the number of different items, (3) the number of items relative to human intervention in the Ocean, (4) the number of mythical elements, and (5) the number of other items not related to the ocean (non-marine) in drawings of girls and boys were not significant (p-value > 0.05, in all cases), except the number of items related to human intervention for which the mean number was higher in boys compared to girls (W = 3708.5, p-value < 0.05).

All Kruskal-Wallis tests used in the comparisons between the three types of school revealed significant results (p-value < 0.05), except for the number of non-marine items in drawings (KW chi-squared = 1.741, p-value > 0.05). In all cases, the mean number of items were higher for countryside schools compared to the urban ones (no major differences between recent and old urban areas schools).

2.3.3. Second school visits: *Acquired knowledge*

The same number of drawings was collected from the second school visit in comparison to the first, applied to the exact same sample of children to guarantee study consistency (Figure 2.6). Unlike the first visit to schools, *Turtle* was the favourite element in **Recent Urban Area**, occurring in close percentages between the two genders. In this second round of drawings, new elements – namely those mentioned during the training sessions – arose. *Trash* was one of them, with an occurrence rate of approximately 20%. The elements *Squid*, *Anglerfish* and *Sea urchin* climbed up, and novel elements such as *Tree* appeared. Other elements such as *Seahorse* descended from position. The remaining elements belong to the lists already known from the first visit to schools. In descendent order: *Man*, *Starfish*, *Shark*, *Seaweed*, *Whale*, *Sand*, *Dolphin*, *Octopus*, *Stone*, among others.

Both girls and boys recorded quite a few turtles in their drawings, but this is higher for girls (64%) corresponding to their dominant element while inferior for boys (58%), who drew both the *Turtle* and *Man* elements in the same percentage. As in the first visit to the Countryside but even more noticeable, there is also a great regularity in the elements represented by the two genders, generally presenting very close percentages and without the existence of elements drawn by only one of them.

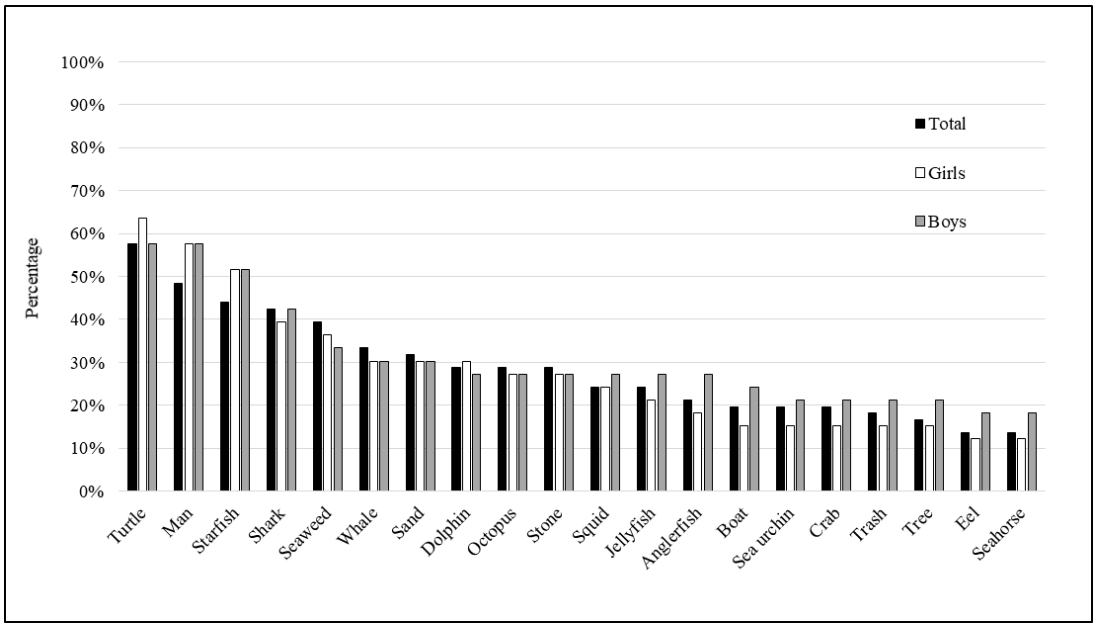

Figure 2.6: The 20 most drawn elements (highest frequency) of the Recent Urban Area, in the second visit to schools, by the total number of students (black bar), and the total number of boys (grey bar) and girls (white bar) - values relative to percentage of drawings that presented each element.

Equally to the first visit, 38 drawings were collected from the two schools in **Old Urban Area** (Figure 2.7). As usually, *Seaweed* was the most observed element in the total and for the girls, while in the case of boys, beyond these, it was also *Shark*. Once again, the elements with higher frequencies in the students' drawings remain practically constant, except for two elements that first appeared in this set of drawings: *Sea Slater*, a littoral woodlouse mentioned during the training presentation in the 2nd visit to schools as a characterizer of the intertidal zone, and *Penguin*, spoken very briefly also during the presentation as one of the references to seabirds.

As has been the rule in the last two areas observed, once again there are no elements exclusive to just one of the genders; however, the elements less portrayed in the children's drawings, *Trash* and *Shell*, were much more represented by the girls. Generally, girls drew more of each element, with the exception of sharks, octopi, whales and men elements.

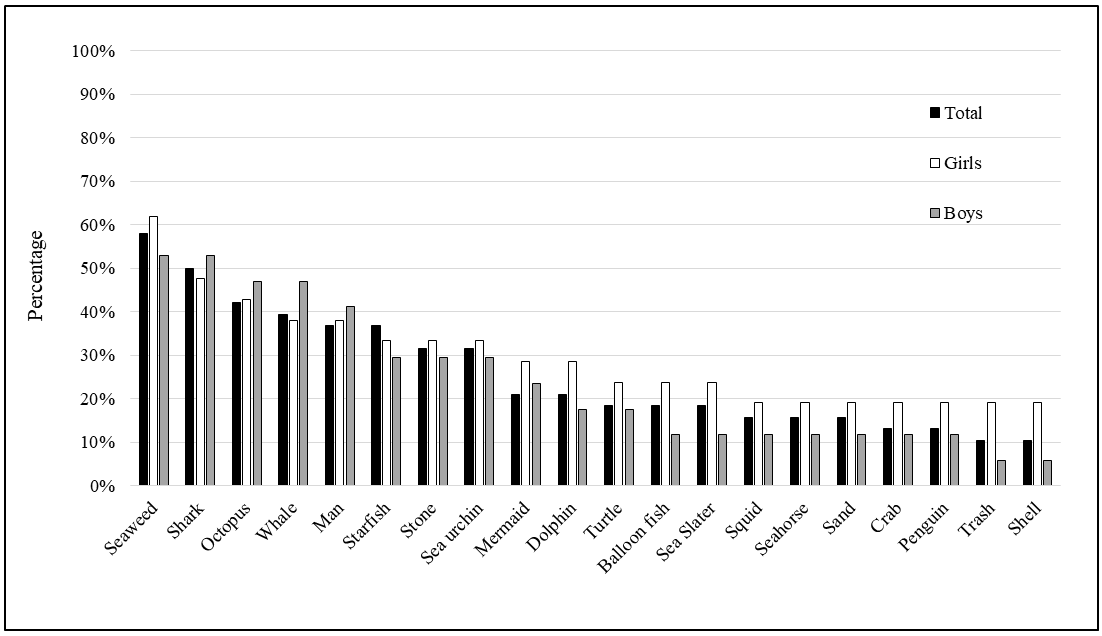

Figure 2.7: The 20 most drawn elements (highest frequency) of the Old Urban Area, in the second visit to schools, by the total number of students (black bar), and the total number of boys (grey bar) and girls (white bar) - values relative to percentage of drawings that presented each element.

In **Countryside**, the predominant element turned out to be *Man* (Figure 2.8). In this area sample, a new element, *sardine*, emerged, despite being the least represented in the total of twenty. The remaining elements visualized in the graphic are already known from the collections of previous drawings, having appeared in all of them.

Although *Man* exists in a greater proportion in girls' drawings (54%), it was also the favourite element of the boys (48%). Again, there is a tendency to the uniformity of the drawings between boys and girls, this time even more evident, since in addition to not having elements associated with only one gender, there is no element that has been drawn from a disparate form between genders (practically equal percentages).

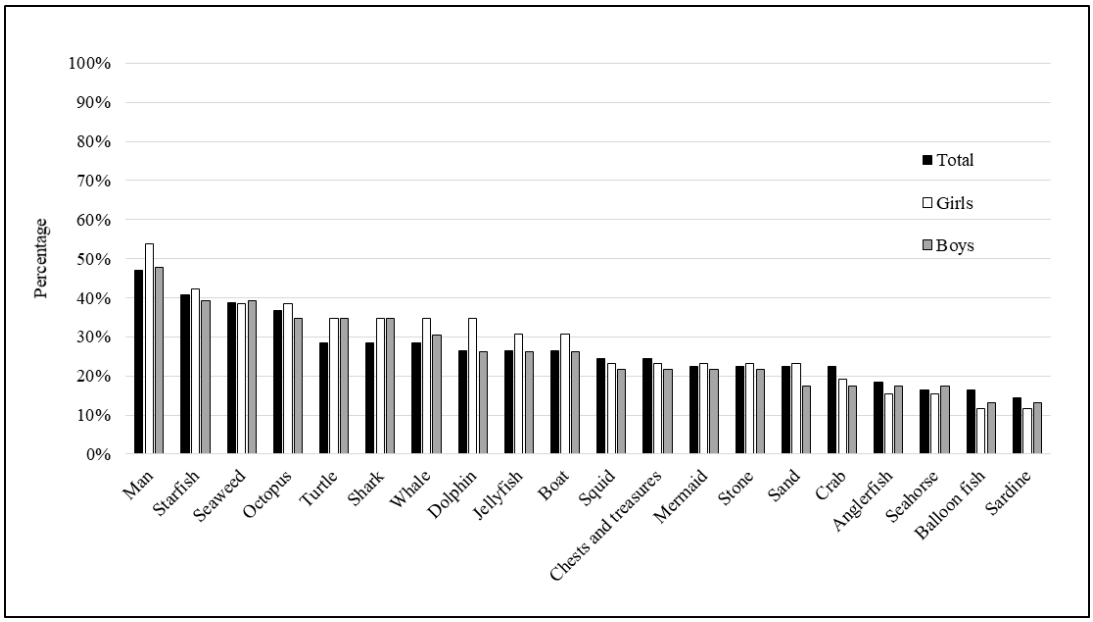

Figure 2.8: The 20 most drawn elements (highest frequency) of the Countryside, in the second visit to schools, by the total number of students (black bar), and the total number of boys (grey bar) and girls (white bar) - values relative to percentage of drawings that presented each element.

The *Marine elements* category was the most widely represented one in the drawing sample of 2nd visit (Figure 2.9), reaching an overall percentage of 81%. The category of *Elements of Human Intervention* increased by 5% from the first visit, featuring in 15% of children's drawings. On the other hand, *Mythical Elements* dropped in position to a frequency of 4%.

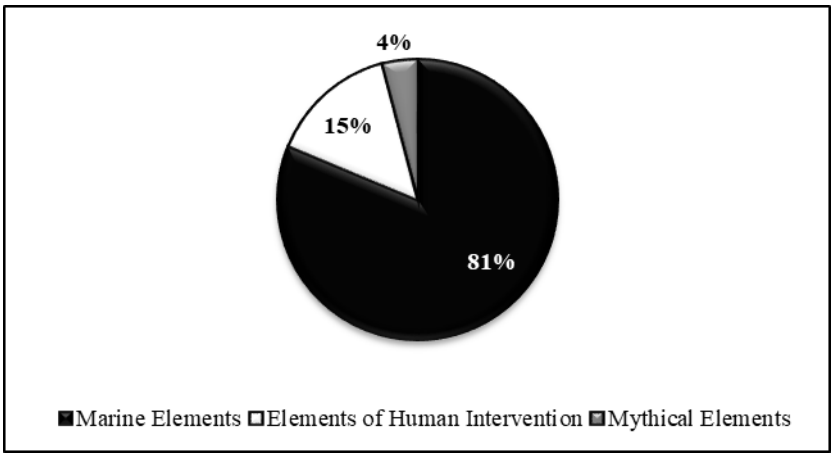

Figure 2.9: Frequency of elements drawn at the second visit to schools, according to the higher categories - Marine Elements (black portion - 81%), Elements of Human Intervention (white portion - 15%) and Mythical Elements (gray portion - 4%).

Looking at the bar chart (Figure 2.10), it can be observed a huge difference in contrast to the first visit, since the *Elements of Human Intervention*, along with the Marine ones, are contained in all the drawings collected (100%) and the Mythical Elements appear much less on the second visit to schools (38,6%).

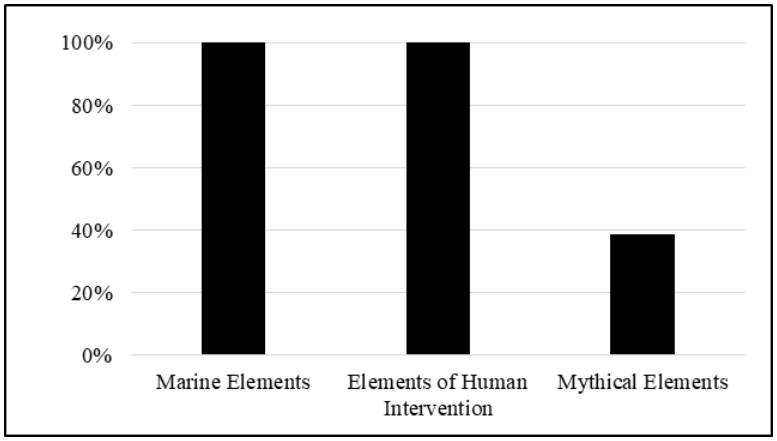

Figure 2.10: Occurrence frequency of the three main categories in the student drawings (percentage of students drawing these categories) of the second visit to schools: Marine Elements (100%), Elements of Human Intervention (100%) and Mythical Elements (39%).

2.3.4. Comparison between *previous* and *acquired knowledge* concerning control and non control-classes

The following chart (Figure 2.11) comprised only the three schools submitted to the training session on marine environments (non-control classes), where are represented 9 categories (which integrate the elements mentioned during the presentation) to ascertain the success of the training session in facilitating information capture and assimilation by students. Reading the graph, four categories can be highlighted to show greater differences from the first to the second visit: *Other crustaceans*, *Trash*, *Depth creatures and Phyto and zooplankton*. The Trash category had the highest success rate with the greatest difference between the "before and after" drawings.

Apart from *Trash*, the “Other crustaceans” group was the one that recorded the biggest difference between the two visits. This category introduced sessile elements often associated with inanimate beings (the children themselves were astonished to realize that they were real animals) - *Barnacles* - and two small organisms equipped with locomotion - *Sea Slater* and *Sand Hopper*. Also, these organisms were used as characterizers of the intertidal zone. Prior to the introduction of these animals, the category was represented by crabs and lobsters, present in a minority of drawings. Regarding the category of *Depth Creatures*, the organisms that integrate it also functioned as characterizers of the ocean depths (not accessible to students) and, through their unusual forms and attributes, sought to arouse curiosity among children. Finally, the last group of plankton, sought to underline the importance of marine life for the sustainability of food chains and as a source of oxygen for humans. At the time of training, these four categories were not represented in children's drawings and after that, a significant percentage of students chose to represent them - ranging from null values or practically null (in the case of *Other Crustaceans*) to values above 10% (for *Other Crustaceans* and *Trash* around 20%).

The category *Other cnidarians* showed a noticeable increase, unlike the categories *Common commercial fish*, *Seabirds* or *Starfish and sea urchins*, which rose slightly in the second visit. This category gathers well-represented organisms such as *Corals*, as well as more peculiar organisms such as the so-called

Beadlet Anemone. The first was already detected in the first round of drawings and the last was introduced, both as characteristic organisms of marine ecosystems, the low depth and coastal zone, respectively. The anemone was chosen for two distinct reasons, its shape resembles a plant, therefore causing confusion between the two, and its curious name that makes it memorable. Corals were chosen due to the attractive environments they create, ideally conquering the interest and contemplation of the students, and because they are also part of an extremely vulnerable ecosystem and at risk of disappearing. In the case of the second category - *Common Commercial Fish* - came in the context of overfishing, despite some of the students had already drawn some fish belonging to this group – like sardines. The third category – *Sea birds* - was also not a novelty for students since they have often portrayed seabirds in their drawings. The reference to this group arose in the context of land-based pollution (urban effluents) and marine pollution (oil accidents) and their consequences for animals such as birds, which ate fish. The fourth category of stars and sea urchins, as the name implies, includes two elements. The first (starfish) appears more often in the students' drawings and more on the 1st visit compared to the 2nd, and the second (sea urchin) is found more often in the drawings of the 2nd visit, since it was mentioned at the time of formation. One single category – *Boats, Baits and Fishing Nets* – revealed a decrease (although very subtle) from the first to the second visit since this category has elements already familiar for the majority, especially for those of the countryside.

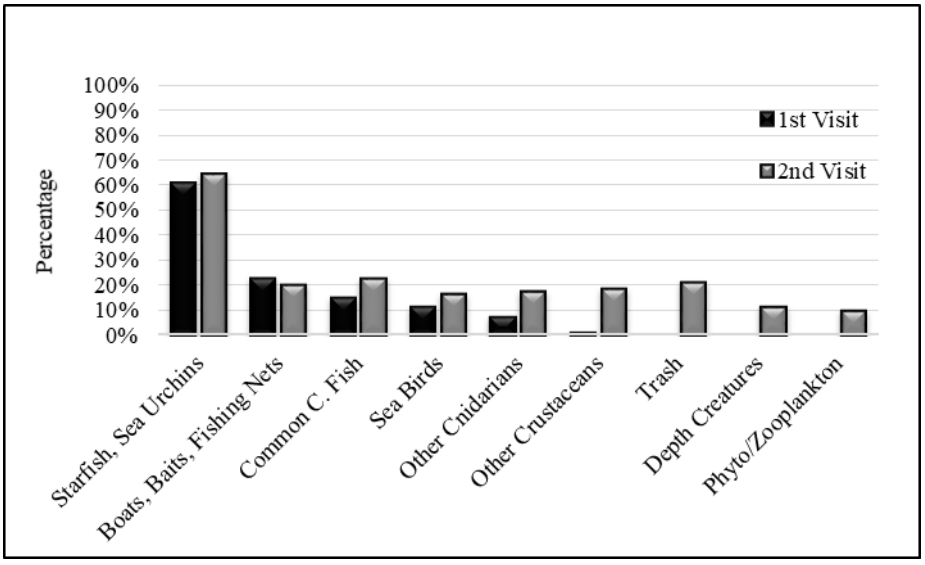

Figure 2.11: Percentage of occurrence in the drawings of the 9 elements presented during the training in the schools; comparison between the two visits, for schools which were subject to training.

Unlike in the trained group of schools, the categories of *Starfish and Sea urchins*, *Common Commercial Fish*, *Seabirds* and *Other Cnidarians* decreased for second-visit drawings (Figure 2.12). None of the students chose *Other Crustaceans* for their creations and there is an almost imperceptible rise in *Phyto and zooplankton* category while *Boats, Baits and Fishing Nets* showed modest growth (35% of appearances). As with the previous group of schools, the categories of *Trash* and *Depth creatures* also showed a rise for the second visit in comparison to the first. However, this change was much feebler than among the three schools that received the training.

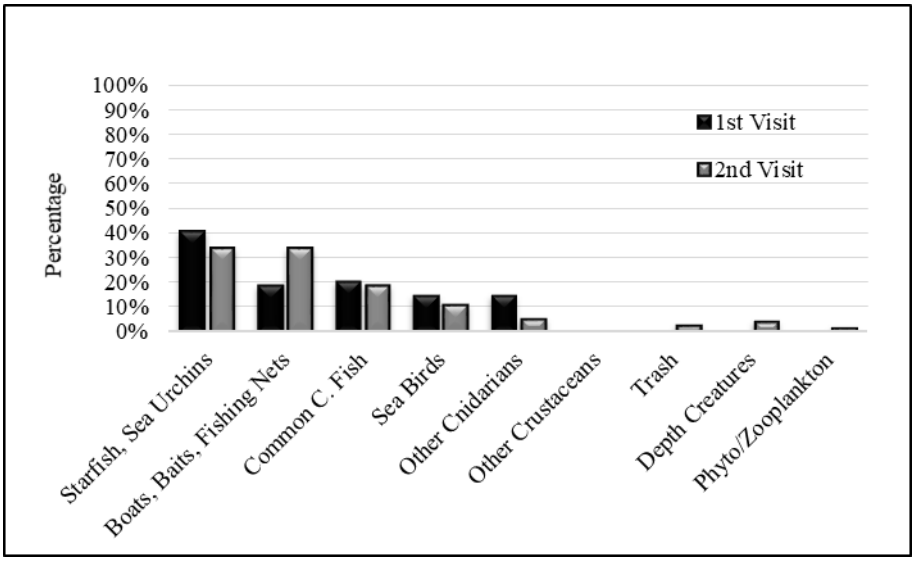

Figure 2.12: Percentage of occurrence in the drawings of the 9 elements presented during the training in the schools; comparison between the two visits, for schools not submitted to training session.

Ordination diagrams resulting from principal component analyses (PCA) supported the evidences drawn from previous charts that evaluated the success of training in schools. **Figure 2.13** represent the first two ordination axes (explaining 25% of variance) of the principal components analysis using data collected in schools of the **Recent Urban Area**. Although there is a high overlap between points relative to both visits, most of the points relative to the second visit were placed in the right side of the diagram. The most important drawing's items related to this pattern were Sq.Oct (Squids and Octopi), Shk (Sharks), Rep (Reptiles), St.SUrch (Starfish and Sea urchins) and C.L.S. (Crabs, Lobsters and Shrimps), that were more common in the second visit drawings.

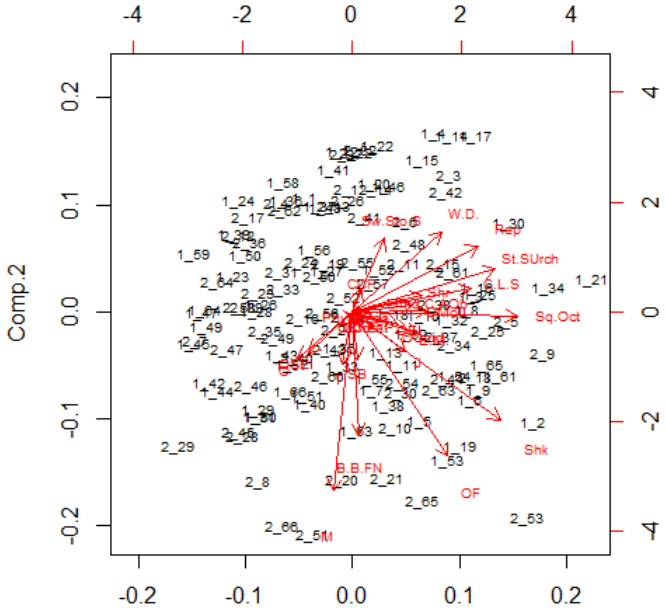

Figure 2.13: Diagram of the first two axes of the principal components analysis performed to data of the group of elements, relative to children's drawings from Recent Urban Area (drawings with codes starting with 1 are relative to the first visit and with 2 to the second visit). Variables: W.D. = Whales and Dophins; OCet = Other cetaceans; Sl.S = Sea lions and Seals; Shk = Sharks; OEl = Other elasmobranchs; Sq.Oct = Squids and Octopi; OMoll = Other mollusks; J = Jellyfish; OCnid = Other cnidarians; Rep = Reptiles; C.L.S = Crabs, Lobsters and Shrimps; OCrus = Other crustaceans; CCF = Common commercial fish; OF = Other fish; Shr = Seahorses; E.M. = Eels and Morays; St.SUrch = Starfish and Sea urchins; SB = Seabirds; DCreat = Depth creatures; Phyto.Zoo = Phyto and zooplankton; Sw.Sto.S = Seaweeds, Stones and Sand; M = Man; B.B.FN = Boats, Baits and Fishing nets; T = Trash; OSEl = Other social elements; Mmd.C.AOb = Mermaids, Castles and Associated objects.

The principal components analysis diagram for the same school but considering only the items addressed in the training session revealed a high homogeneity in the contents of all the drawings (Figure 2.14). However, it is possible to note that most of the points that were placed in the outer part of the diagram were mainly from the second visit and were associated with a higher number of Other cnidarians (OCnid), Other crustaceans (Ocrus) and Trash (T).

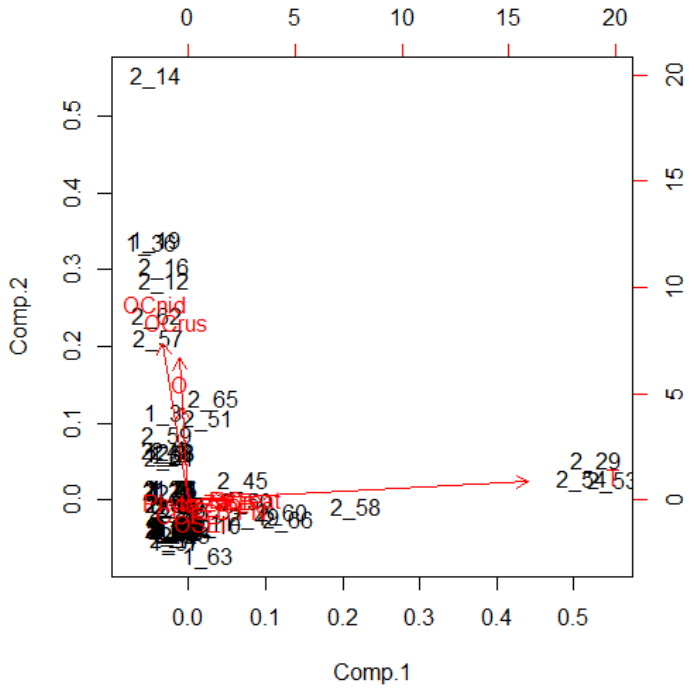

Figure 2.14: Diagram of the first two axes of the principal components analysis performed to data of the group of elements addressed in the training session, relative to children's drawings from Recent Urban Area (drawings with codes starting with 1 are relative to the first visit and with 2 to the second visit). Variables: OCnid = Other cnidarians; OCrus = Other crustaceans; CCF = Common commercial fish; SB = Seabirds; DCreat = Depth creatures; Phyto.Zoo = Phyto and Zooplankton; St.SUrch = Starfish and Sea urchins; B.B.FN = Boats, Baits, Fishing Nets; T = Trash.

For the **Old Urban Area**, the ordination diagram obtained accounted for 27% of the variance in the first two axes and presented a similar pattern to the one reported for Recent Urban Area (Figure 2.15), although the overlap between visits was more pronounced. For the analysis that considered only the drawing elements focused in the training session (Figure 2.16); the first two ordination axes represented 59% of the variance), results were also similar to the ones described for the Recent Urban Area. In this case, the elements that were more represented in the second visit were Trash (T) and Phyto and zooplankton (Phyto.Zoo).

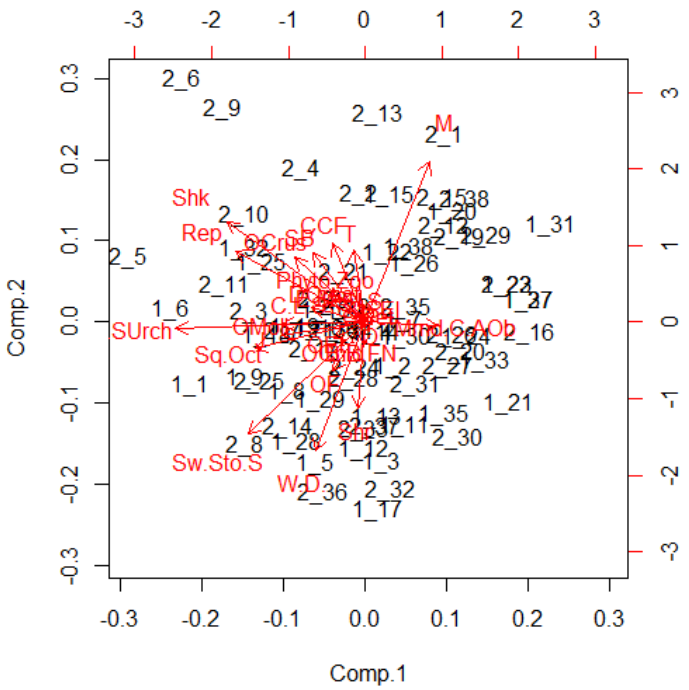

Figure 2.15: Diagram of the first two axes of the principal components analysis performed to data of the group of elements, relative to children's drawings from Old Urban Area (drawings with codes starting with 1 are relative to the first visit and with 2 to the second visit). Variables: W.D. = Whales and Dophins; OCet = Other cetaceans; Sl.S = Sea lions and Seals; Shk = Sharks; OEl = Other elasmobranchs; Sq.Oct = Squids and Octopi; OMoll = Other mollusks; J = Jellyfish; OCnid = Other cnidarians; Rep = Reptiles; C.L.S = Crabs, Lobsters and Shrimps; OCrus = Other crustaceans; CCF = Common commercial fish; OF = Other fish; Shr = Seahorses; E.M. = Eels and Morays; St.SUrch = Starfish and Sea urchins; SB = Seabirds; DCreat = Depth creatures; Phyto.Zoo = Phyto and zooplankton; Sw.Sto.S = Seaweeds, Stones and Sand; M = Man; B.B.FN = Boats, Baits and Fishing nets; T = Trash; OSEl = Other social elements; Mmd.C.AOb = Mermaids, Castles and Associated objects.

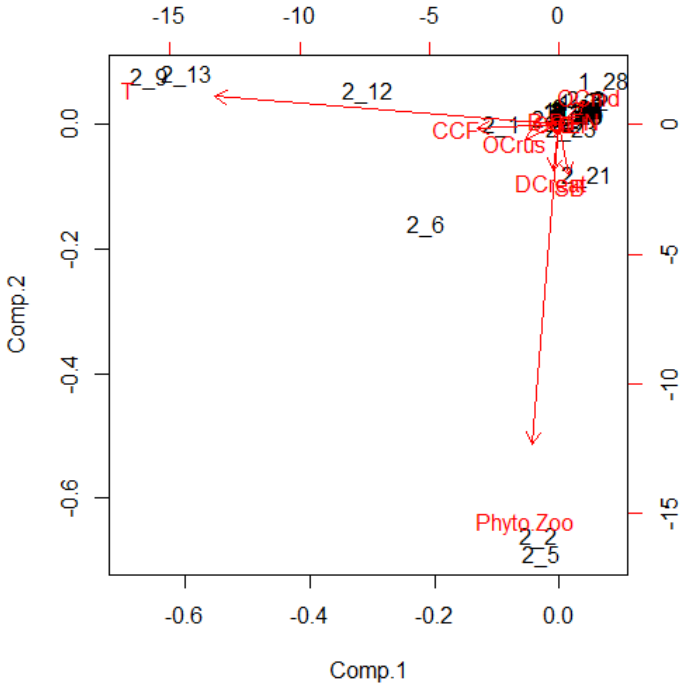

Figure 2.16: Diagram of the first two axes of the principal components analysis performed to data of the group of elements addressed in the training session, relative to children's drawings from Old Urban Area (drawings with codes starting with 1 are relative to the first visit and with 2 to the second visit). Variables: OCnid = Other cnidarians; OCrus = Other crustaceans; CCF = Common commercial fish; SB = Seabirds; DCreat = Depth creatures; Phyto.Zoo = Phyto and Zooplankton; St.SUrch = Starfish and Sea urchins; B.B.FN = Boats, Baits, Fishing Nets; T = Trash.

Finally, for the **Countryside**, results presented the same patterns evidenced for the other areas, being the elements more related to the second visit Starfish and Sea urchins (St. SUrch); Boats, Baits and Fishing nets (B.B.FN); Common commercial fish (CCF) and Seabirds (SB) (Figures 2.17 e 2.18). The ordination diagrams of these principal components analyses accounted for 28% and 78%, respectively, of the variance in the first two axes.

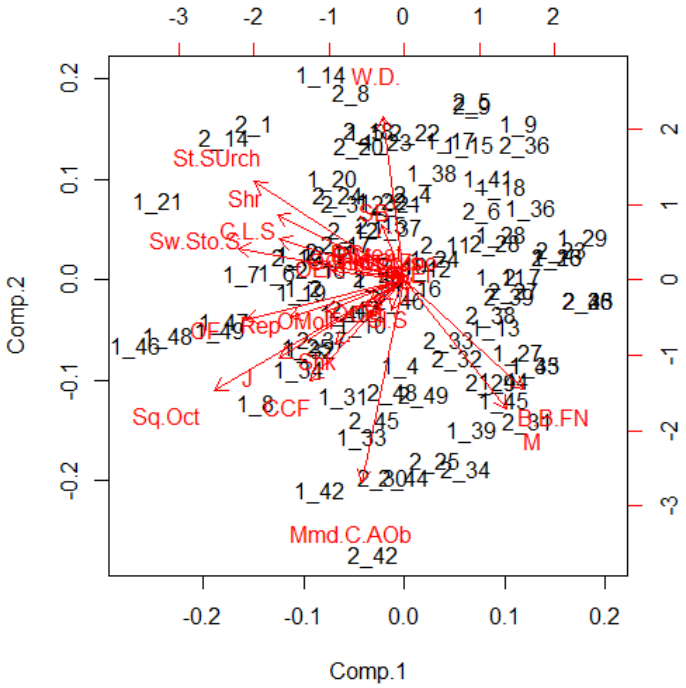

Figure 2.17: Diagram of the first two axes of the principal components analysis performed to data of the group of elements, relative to children's drawings from Countryside (drawings with codes starting with 1 are relative to the first visit and with 2 to the second visit). Variables: W.D. = Whales and Dophins; OCet = Other cetaceans; Sl.S = Sea lions and Seals; Shk = Sharks; OEl = Other elasmobranchs; Sq.Oct = Squids and Octopi; OMoll = Other mollusks; J = Jellyfish; OCnid = Other cnidarians; Rep = Reptiles; C.L.S = Crabs, Lobsters and Shrimps; OCrus = Other crustaceans; CCF = Common commercial fish; OF = Other fish; Shr = Seahorses; E.M. = Eels and Morays; St.SUrch = Starfish and Sea urchins; SB = Seabirds; DCreat = Depth creatures; Phyto.Zoo = Phyto and zooplankton; Sw.Sto.S = Seaweeds, Stones and Sand; M = Man; B.B.FN = Boats, Baits and Fishing nets; T = Trash; OSEl = Other social elements; Mmd.C.AOb = Mermaids, Castles and Associated objects.

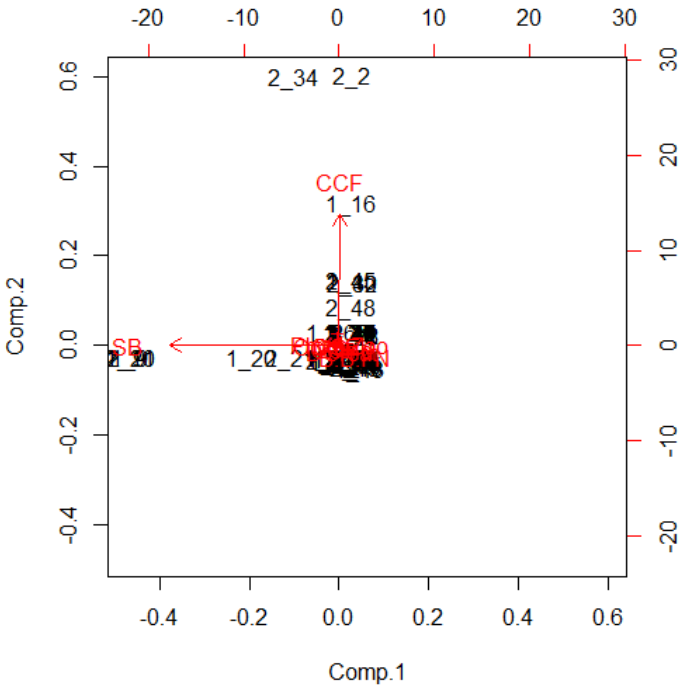

Figure 2.18: Diagram of the first two axes of the principal components analysis performed to data of the group of elements addressed in the training session, relative to children's drawings from Countryside (drawings with codes starting with 1 are relative to the first visit and with 2 to the second visit). Variables: OCnid = Other cnidarians; OCrus = Other crustaceans; CCF = Common commercial fish; SB = Seabirds; DCreat = Depth creatures; Phyto.Zoo = Phyto and Zooplankton; St.SUrch = Starfish and Sea urchins; B.B.FN = Boats, Baits, Fishing Nets; T = Trash.

2.4. Discussion

Children's drawings bring together knowledge and visual perceptions, which are displayed in the construction of their mental representations, also, valuable information about the development of environmental perceptions, they may possess, can be derived specifically from them (Farokhi & Hashemi, 2011). It is through these perceptions that the experiences occur and are attributed meanings that later will be converted into thoughts, making human reality a product of perspectives (Alerby, 2000).

The environmental reality, according to some studies directed at children (Sorin & Gordon, 2012), is a reality of which children are relatively conscious. A similar study by Ozsoy (2012) has shown that children commonly associate the term "environment" with green spaces and often include trees and grass in their drawings as well as problems associated with these environments, such as urban and atmospheric pollution (the most represented) and deforestation. However, negative impacts on marine environments were also portrayed in the drawings of these schoolchildren, which resulted in the death of fish due to the urban litter dumping in the water (Özsoy, 2012).

Both studies are consistent with the results obtained for the present study, since pollution was also revealed as an emerging category in this case, making evident the positive impact of the training session held in schools. The greater attention given to pollution may have more than one explanation. First, children interact with the ocean under recreational circumstances, most often during family vacations or in colonies with schools, making this environment emerge from a leisure perspective where children participate in games and activities and interaction with nature in childhood through play activities has a profound impact on their physical and mental status (King & Church, 2013; Rydberg & Falck, 2000). When it is said that these environments can be lost or spoiled it is seen as a threat to their enjoyment, causing the theme to arouse their attention and concern (Bayne *et al.*, 2015).

Furthermore, the way in which pollution, as a subject, has been addressed in this project and the examples shown, may have contributed to the greatest importance given to it. Images of injured and / or dead animals, such as birds and sea lions were used to raise awareness about the impacts caused by marine pollution. According to Palmer (1995), 6-year-olds worry in a way that emphasizes animal welfare rather than their own well-being (Palmer, 1995). In addition, children make positive judgments about their competencies, which leads them to believe that they can improve things and changing the world (Mantzicopoulos *et al.*, 2008; Marsh *et al.*, 2002), and in this case eliminating environmental marine problems. As mentioned, children have an optimistic view of events and most represent the future of the environment as something clean, beautiful and idyllic (Alerby 2000; Özsoy, 2012).

Most of the unknown categories for the students were the ones that registered the greatest increase in the second set of drawings (*Other crustaceans*, *Depth Creatures* and *Phyto/Zooplankton*), it shows that the new knowledge worked as stimulator of the wonder and interest of these children and, therefore, that the learning was successful. However, despite a smaller difference justified by knowledge already existing on the first visit, a rise is also visible in other categories which include elements well known to most people (*Other Cnidarians*, *Common Commercial Fish* and *Seabirds*). In the case of Common Commercial Fish - students were already familiar with most of the spoken species, since they are sold in supermarkets and eaten at mealtimes while despite seabirds had already appeared in the first drawings collected, the students referred to them generically as "little beach birds" and when asked about the bird's name they did not know specifically what it was, most of the time.

As a rule, children draw elements closer to the reality to which they are accustomed rather than elements that, although they know they exist or have already heard of them, are more abstract (Bayne *et al.*, 2015) - the previously unknown elements ceased to be abstract from the moment they were exhibited to them. This becomes quite evident in the choice of elements illustrated throughout the drawings. The most dominant element in the overall drawings of the students was *Seaweed*. This did not happen in the first visit to the schools of the Countryside, where it was replaced by Starfish; and on the 2nd visit where it happened to be Turtle for the Recent Urban Area and Man for the Countryside. The fact that *Seaweed* was present in a large majority of the drawings can be explained by it being an element of environmental framing, as well as *Starfish*, often appearing along the coast, and in large quantities, during the bathing season, and can therefore be often observed closely by the children. The turtle is a common animal in the daily life of many children since it can be acquired as a domestic animal and perhaps for that reason it also emerges as a dominant element.

The *Man* element, in addition to being the principal element of choice of the Countryside, is characterized by a high percentage of occurrence in the majority of drawings in all the areas, more related with male representations (only in the 2nd visit to the Countryside it is also predominant among the girls, which may be due to the presentation focusing on the Man and its impacts on the ocean). The insistence on the representation of the human figure, contrary to the reports of some authors (Littledyke, 2004; Loughland & Reid, 2002; Shepardson *et al.*, 2007), is in agreement with other similar studies with children, where the presence of this element was often detected in drawings among other living organisms, which in addition to proving that children consider man as an integral part of nature, also proves that they know that humans are affected by environmental impacts (Oszoy, 2012). On the other hand, children at this age are quite egocentric and have a high self-esteem, and perhaps that is why many of their representations emphasize Man (feminine in girls and masculine in boys) as a reflection of themselves (Tunnicliffe, 2001; Cherney *et al.*, 2006).

Previous studies have observed illustrations produced by children depicting characters from children's fiction, that aroused their interest (Sorin & Gordon, 2012). In the year 2017 (when the student drawings were obtained), there were no animation films that portrayed any of the elements that appeared in the drawings. However, in the year 2016, not so distant from when these data were collected, there were released two films whose histories unfold in marine environments: Finding Dori (in June) and Moana (in November) (IMDb a,b). The first includes several organisms both on the surface and deep water, such as various fish, sharks, whales, octopuses, sea lions, rays, sea horses and crabs, which appear in children's drawings. The second includes images of shells, whelks, sea snails, corals and crabs but also many boats, sailor and fishermen. The children may have had access to these films and this may justify the inclusion of some of the elements observed in some of the drawings, however this information could not be confirmed.

This study considered geographic factors - related to the area where the school was inserted (countryside vs urban) and demographic factors - gender and age. However, the influence of other demographic and population factors was not tested, namely, in the first case, the proximity to the ocean and in the second case the social class of the students and their families. The hypothesis would be that children who maintain a close contact and personal attachment with the ocean would more easily develop a greater sensitivity to all their issues and that children living under better financial circumstances are also more receptive to the subject. This was a matter of logistics for the first, and because the school cannot provide such statistics, for the second, so it was decided to divide the schools belonging to rural and urban areas to try and test the "Nature" factor, since the "Sea" factor proved impossible to test. The decision to divide the Urban Area into recent and old was intended to mean that the oldest schools also corresponded to

the most economically disadvantaged schools and the most recent schools to those with the best conditions. However, this assumption is somewhat speculative and somewhat elitist, and could not be tested. The characterization of the civil parish where the school was included instead of the school population could be used as a last resort but nevertheless it was verified that the civil parishes were quite heterogeneous in that sense. Furthermore, there is some discrepancy in the authors' opinions regarding the relevance or not of the inclusion of the socioeconomic factor and some of them argue that there is a weak correlation between the economic status of the families and environmental concern (Hawthorne & Alabaster, 1999). However, this factor may have been a constraint on the opportunities and experiences that some students may have had to the detriment of others, since higher income families may provide activities that require monetary efforts such as visiting zoos or museums.

Throughout the study there were factors that could have been conditioning on the differences among students, which could not be evaluated but could not be removed either. These factors can be classified into three types: external factors related to the school, factors inherent to the students and factors related to intervention in these schools. School-related factors include school textbooks, learning materials, and teacher interests. The content of school textbooks - especially science textbooks - may have several images and pictures that are seen by students daily and the same thing happens with the materials placed at their disposal and even the way the classroom is decorated can act as a stimulus visual. Also, whether the teacher has an intrinsic interest or not in the marine environment can cause he/she to insert examples of this topic in his/her educational discourse.

Concerning the genuine and intrinsic interests of the students, they did not draw on the marine environment involuntarily, having been persuaded to do so, which might irritate some (as happened in some cases) and determined what they chose to draw (Mantzicopoulos *et al.*, 2008). Also, the skill with which they produced the drawings and their memory abilities (Cherney *et al.*, 2006) may have acted in different ways: Students have different work rhythms, and some have delivered their works faster than others (although the time stipulated was the same for all), which may have generated some pressure on those who were behind and may have led them not to represent everything they remembered, since children of this age are quite competitive (Gneezy & Rustichini, 2004).

The fact that they were competitive and liked to be praised might also have led to the later ones copying elements from the drawings of their more advanced colleagues, since at the time of delivery they asked about the performance of their drawings, and this was a possible factor involved in the study intervention. It is added that the children inevitably spoke to each other, although they were told that it was individual designs and could not copy their colleagues, which meant that, similar to what happened in a study in New Zealand (Bayne *et al.*, 2015), their thoughts were influenced by others. Past all this, students were asked to draw what they believed existed underwater and it is known from previous studies that children's desires overlap with the tasks assigned to them (Anning & Ring, 2009; Sorin & Gordon, 2012). In conclusion, they access their knowledge in very different ways and this access depends on factors such as their abilities and interests and exposure to different stimuli (Bowker, 2007).

Despite all the issues highlighted, it was found that the objective of acquiring new knowledge was fulfilled, being the topic of greatest interest the marine litter. Given that the problem of pollution is considered to be one of the main problems affecting the marine environment, its awareness becomes fundamental, allowing the growth of children to be accompanied by ethical growth, justified by the adoption of more correct and less harmful attitudes to the environment. In addition, it was reinforced that the use of drawings as a source providing their representations and environmental perceptions was successful and from this it was possible to draw several conclusions. It was demonstrated that students,

even the youngest, have a great sensitivity to the environmental problems of the oceans, and that more dramatic and shocking approaches, worked at these ages.

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CHAPTER 3:

Final remarks

3.1. Final remarks

With this study it was possible to demonstrate that young children were highly sensitive to environmental issues, and pollution-related problems have particularly attracted their attention and concern, despite all the new and different subjects presented to them – both biological, such as strange organisms from the deep sea, hidden organisms of the coastal zone, colorful coral reefs; as well as those of anthropic nature, such as oil platforms, aquaculture systems and renewable energies, among others - pollution and direct human impact on the marine environment were one of their main concerns. Issues such as marine litter and coastal pollution by marine debris might be something that they easily related to in a daily basis, and may be, in fact, one issue about which they could act upon. This is interesting and hopeful for the future as marine litter is probably the greatest issue of our times.

Approaches which use visual stimuli to represent cause-and-effect events had an impact on children's emotions and memory and can be directed to any child, regardless of their gender or the reality in which they are involved, since we worked with children who bring about different histories and experiences. Thus, the first step in changing behaviors that promote a more responsible future is fulfilled. Raising awareness about the existence of marine environmental problems and the so needed actions to correct them is very important at young ages and kids might developed into interventive and conscious adults. Future studies are still needed to understand to what extent these expositions to knowledge led to the change of participants' habits or behaviors, which would demand for long-term continued studies with focal groups. Even though immediate short-term impacts on the representations of, and consequently knowledge acquisition by the children were determined, it is not possible to determine the duration of these effects. The transmission of knowledge is a process that must be reinforced and also put into practice on a regular basis, so that its success is long-lasting. In addition, this experience has detected different levels of knowledge, in terms of complexity and level of detail, in very particular and rare cases. In this way, it would be interesting, in a later approach, to identify the individual sources of this knowledge, not related to the training applied in schools during this work. Comparisons between different cultural realities, either across Europe and across the globe would provide very interesting results and eventually ways of producing organized and concerted actions throughout different countries.

This work used a multidisciplinary approach that relates both Human and Environment components, whose relationship needs to be further studied in order to ensure the existence of a future for both. Our westernized societies must recognize the fragilities of the Ocean as critical to maintain the health of our planet, and should promote measures urgently to better conserve and manage all marine ecosystems.
Although the current scenario is not the most motivating there is still hope and people willing to change. It is time to grow children and mentalities and with them also to grow solutions for a blue and green world.

APPENDICES

Annex I

Table 1: Count of the number of total elements recorded in the drawings of the students (88 lines for each element) distinguishing 1st and 2nd visits, control and non-control classes and boys and girls.

	1st Visit			2nd Visit					
				Control			Non-Control		
	Boy	Girl	**Total**	Boy	Girl	**Total**	Boy	Girl	**Total**
Turtle	28	28	56	15	15	30	15	21	36
Man	81	54	135	36	33	69	18	24	42
Mermaid	7	31	38	10	22	32	0	2	2
Dolphin	33	46	79	9	16	25	11	18	29
Squid	16	5	21	12	8	20	11	11	22
Octopus	46	55	101	10	14	24	17	16	33
Shark	43	24	67	19	11	30	28	15	43
Eel	15	5	20	4	1	5	7	3	10
Jellyfish	19	32	51	5	9	14	10	17	27
Boat	17	7	24	5	7	12	9	6	15
Whale	25	26	51	13	15	28	18	13	31
Trash	0	0	0	12	0	12	28	44	72
Seahorse	12	23	35	1	8	9	10	10	20
Killer whale	8	0	8	3	4	7	1	2	3
Anglerfish	7	10	17	4	0	4	16	8	24
Seaweed	212	187	399	33	74	107	59	70	129
Starfish	52	109	161	14	27	41	26	47	73
Whelk	1	6	7	0	3	3	3	9	12
Shell	8	26	34	4	17	21	12	16	28
Stone	56	83	139	36	33	69	13	15	28
Sand	24	30	54	3	7	10	13	15	28
Coral Reef	10	3	13	1	4	5	12	8	20
Clownfish	3	10	13	2	2	4	4	5	9
Tree	5	0	5	2	1	3	8	15	23
Sea urchin	11	10	21	8	13	21	9	25	34
Chests and treasures	21	22	43	6	8	14	2	0	2
Ray	9	8	17	1	3	4	5	2	7
Capture Instruments	10	3	13	4	3	7	6	2	8
Barnacles	0	2	2	0	0	0	6	15	21
Crab	15	20	35	4	6	10	15	6	21
Building/House	2	0	2	3	2	5	1	4	5
Oyster	5	8	13	1	4	5	3	1	4
Balloon fish	16	25	41	6	6	12	4	4	8
Creatures from the depths	0	0	0	4	0	4	7	2	9
Snail	8	16	24	3	5	8	1	0	1
Hammer shark	8	3	11	4	3	7	0	1	1
Submarine	4	7	11	6	3	9	1	0	1
Swordfish	11	7	18	8	4	12	2	0	2
Sea birds	10	29	39	11	1	12	4	28	32
Volcano	1	2	3	0	0	0	13	2	15
Sardine	1	7	8	5	3	8	8	5	13
Phytoplankton	0	0	0	1	0	1	7	29	36
Bioluminescent mushrooms	0	0	0	0	0	0	13	5	18
Good Habits	0	0	0	0	0	0	1	3	4
Sea Slater	0	0	0	0	0	0	2	6	8
Sand Hopper	0	0	0	0	0	0	5	9	14
Gilt-Head Bream	0	0	0	0	1	1	7	2	9
Sea lion	0	0	0	3	1	4	1	2	3
Sea Anemone	3	10	13	0	1	1	3	2	5

Flounder	1	6	7	0	0	0	0	4	4
Sea Spider	0	1	1	0	0	0	0	2	2
Catfish	4	0	4	2	0	2	3	0	3
Penguin	4	5	9	0	0	0	1	5	6
Moray Eel	3	0	3	0	0	0	3	0	3
Common Sole	3	1	4	0	0	0	0	4	4
"Monster"	2	1	3	0	0	0	0	0	0
Shrimp	1	2	3	1	0	1	0	0	0
Narwhal	4	2	6	0	0	0	0	0	0
Whale shark	1	3	4	1	0	1	0	0	0
Sea snake	1	4	5	0	1	1	2	0	2
Butterfly	1	1	2	0	1	1	0	0	0
Sun hat	3	3	6	0	0	0	1	3	4
Rainbow	2	2	4	0	1	1	1	0	1
Car	9	0	9	0	0	0	0	0	0
Lobster	1	2	3	0	0	0	0	0	0
Crocodile	3	2	5	5	0	5	0	0	0
Cartoon	2	2	4	1	0	1	0	0	0
Weedy Seadragon	1	1	2	1	0	1	0	0	0
Castle	2	3	5	1	0	1	0	0	0
Platypus	1	2	3	2	0	2	0	0	0
Otter	0	1	1	1	0	1	0	0	0
Hippopotamus	0	1	1	1	0	1	0	0	0
Seal	0	1	1	1	0	1	0	0	0
Shovel	1	0	1	1	0	1	0	0	0
Mussel	1	0	1	0	0	0	0	1	1
Planet	0	0	0	0	0	0	0	1	1
Beadlet Anemone	0	0	0	0	0	0	3	4	7
Worm	0	0	0	0	0	0	0	1	1
Flying Fish	0	0	0	6	0	6	0	0	0
Trident	0	0	0	1	0	1	0	0	0
Lion-Fish	0	0	0	0	0	0	0	3	3
Codfish	0	0	0	0	0	0	0	1	1
Tuna Fish	0	0	0	0	0	0	0	1	1
Sloth	0	0	0	1	0	1	0	0	0
Needlefish	0	0	0	0	0	0	1	0	1
Vampire-Fish	0	0	0	0	0	0	1	0	1
Zonation	0	0	0	0	0	0	1	2	3
Tortoise	0	0	0	0	1	1	0	0	0

Annex II

Figure 1: Drawing of a boy from Recent Urban Area (1st visit) demonstrating a high level of detail and complexity.

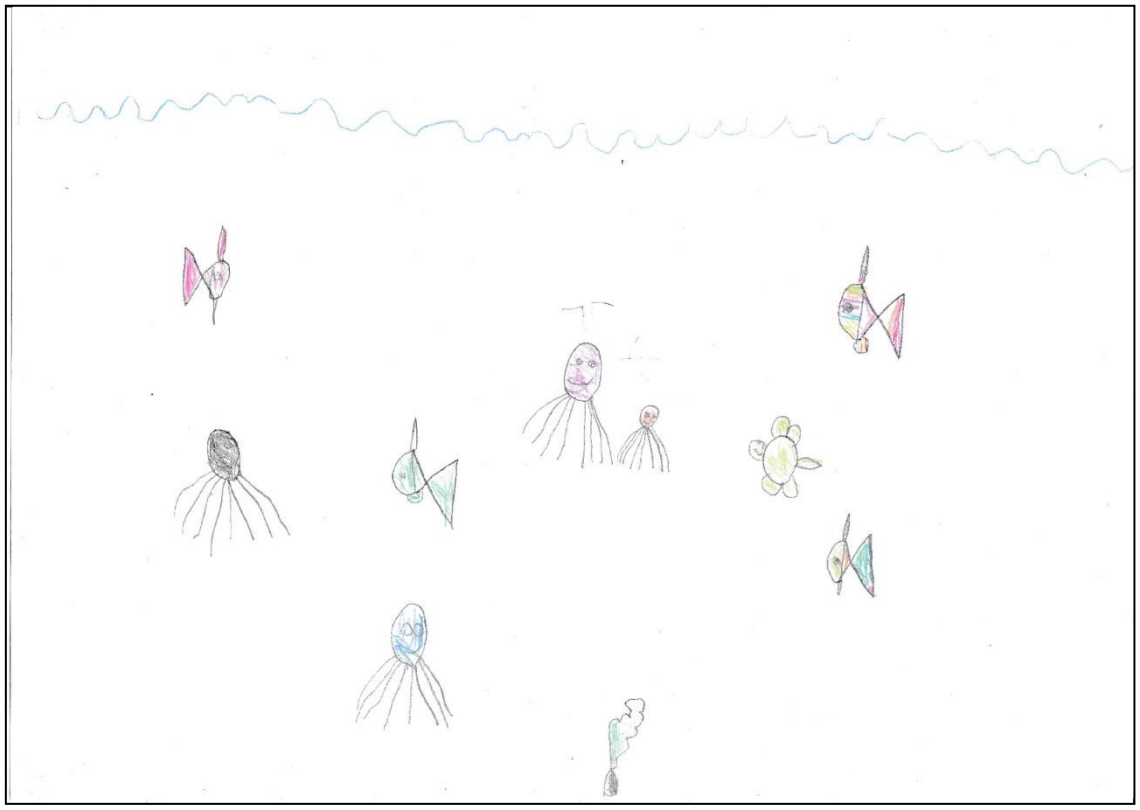

Figure 2: Drawing of a girl from recent urban area (1st visit) that reveals a low degree of complexity, with very simple figures and shapes.

Figure 3: Drawing of a girl from Recent Urban Area (1st visit) demonstrating high degree of detail and complexity.

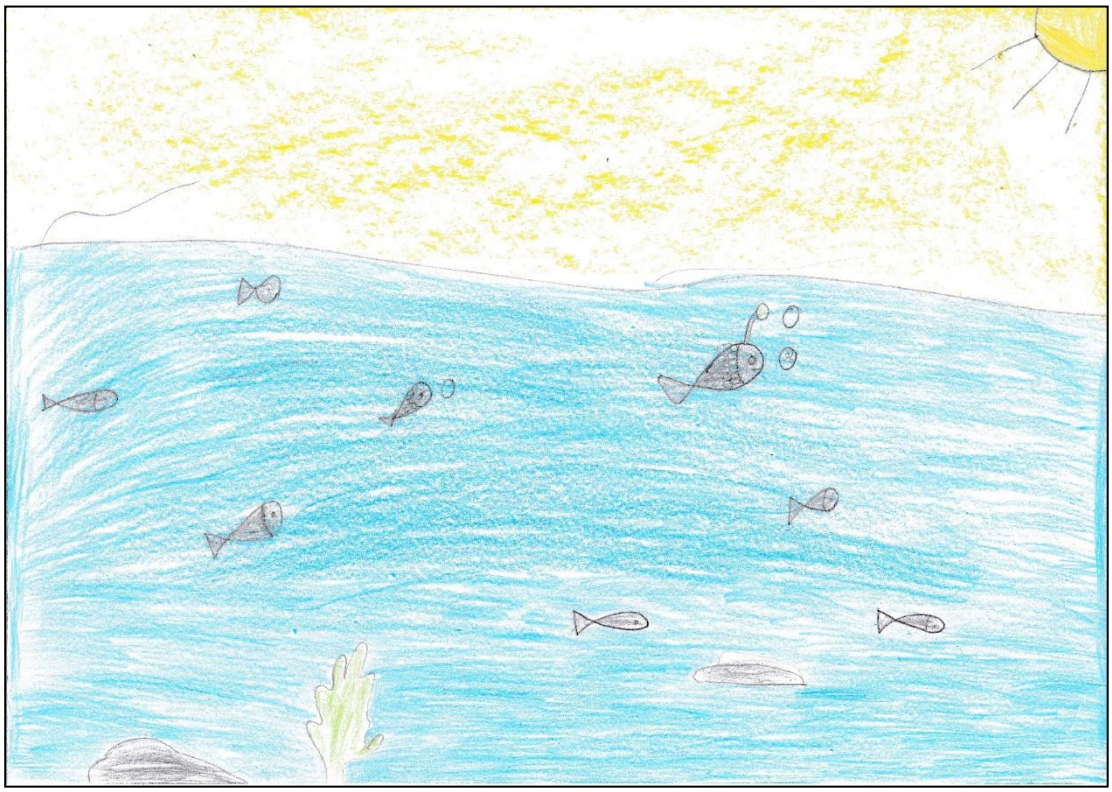

Figure 4: Drawing of a girl from Recent Urban Area (1st visit) that reveals a low degree of complexity, presenting practically only framing elements such as seaweeds, rocks and standard fish.

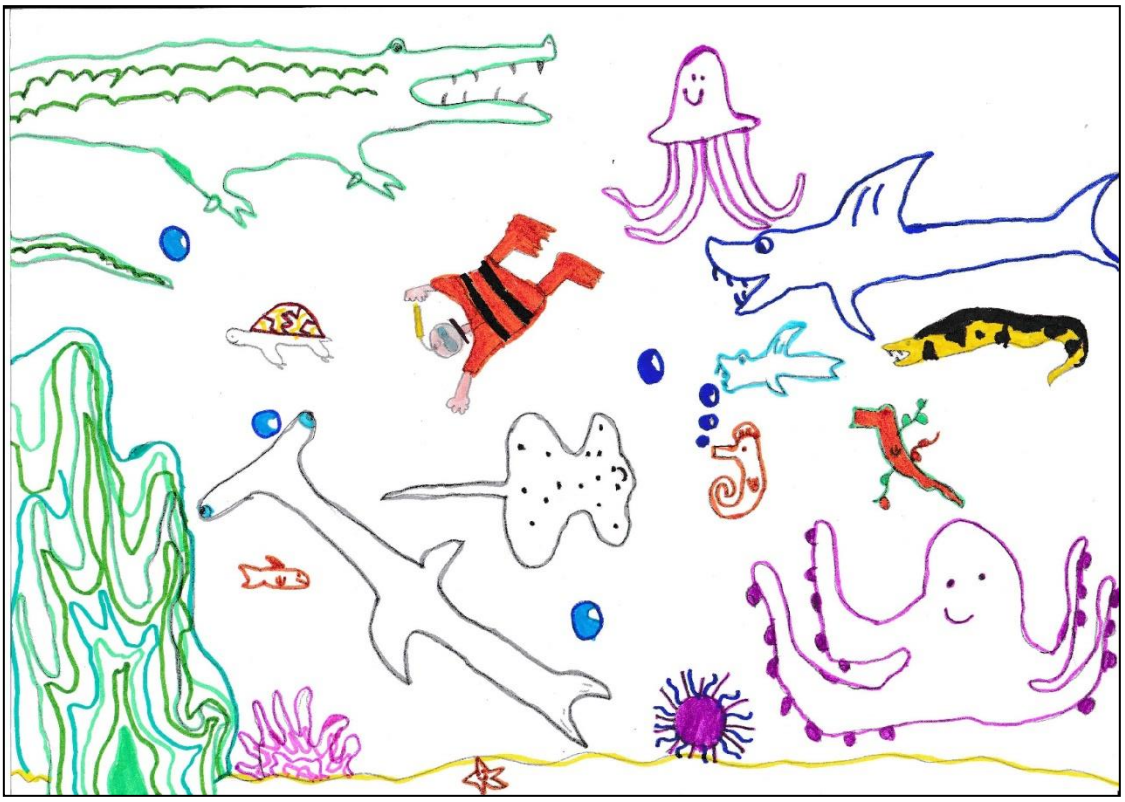

Figure 5: Drawing of a boy from countryside (1st visit) demonstrating a high level of detail and complexity.

Figure 6: Drawing of a girl from recent urban area (1st visit) that reveals a low degree of complexity, only depicting seaweeds, rocks and standard fish.

Figure 7: Drawing of a girl from recent urban area (1st visit) with lots of color, stars, butterflies and laces.

Figure 8: Drawing of a boy from recent urban area (1st visit) with sharks throwing their tongue out.

Figure 9: Drawing of a girl from old urban area (1st visit) with animals with eyelashes quite exaggerated and mythical elements - mermaids.

Figure 10: Drawing of a boy from old urban area (1st visit) with expanded male human figures known from the cartoons, not belonging to marine context.

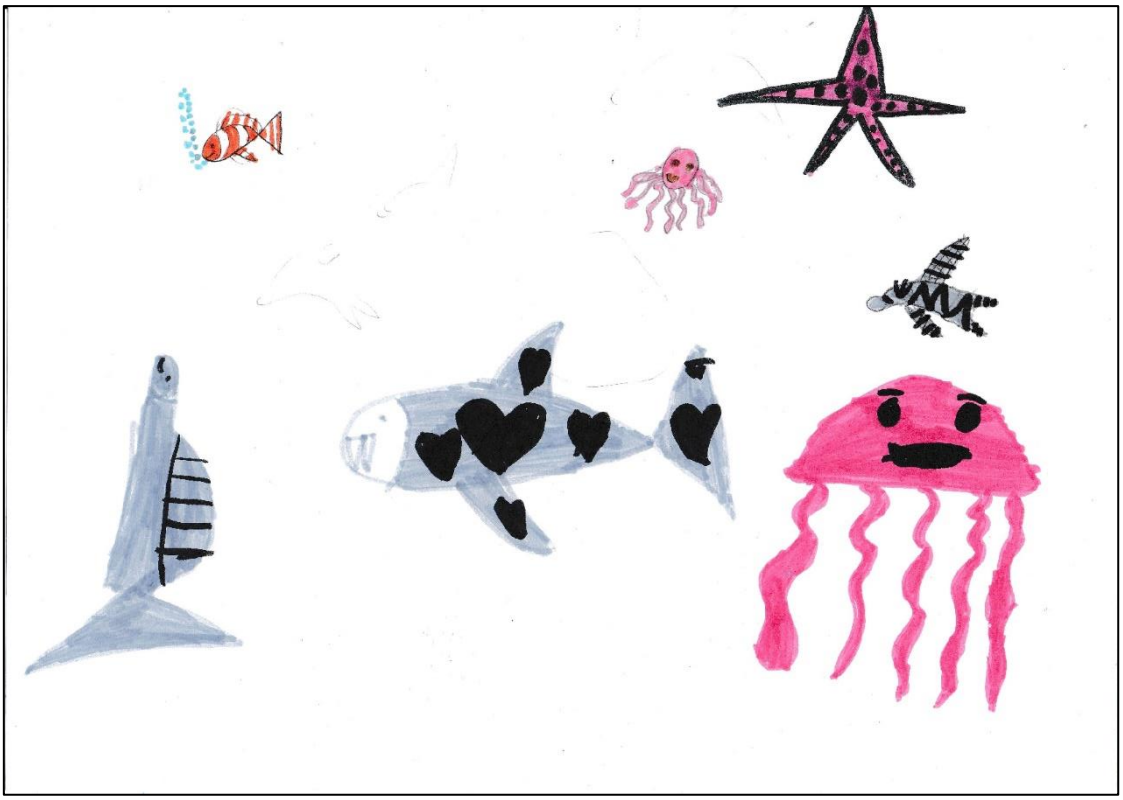

Figure 11: Drawing of a girl from old urban area (1st visit) with animals adorned with hearts.

Figure 12: Drawing of a boy from countryside (first visit) very dramatic, with marine monsters and pirates.

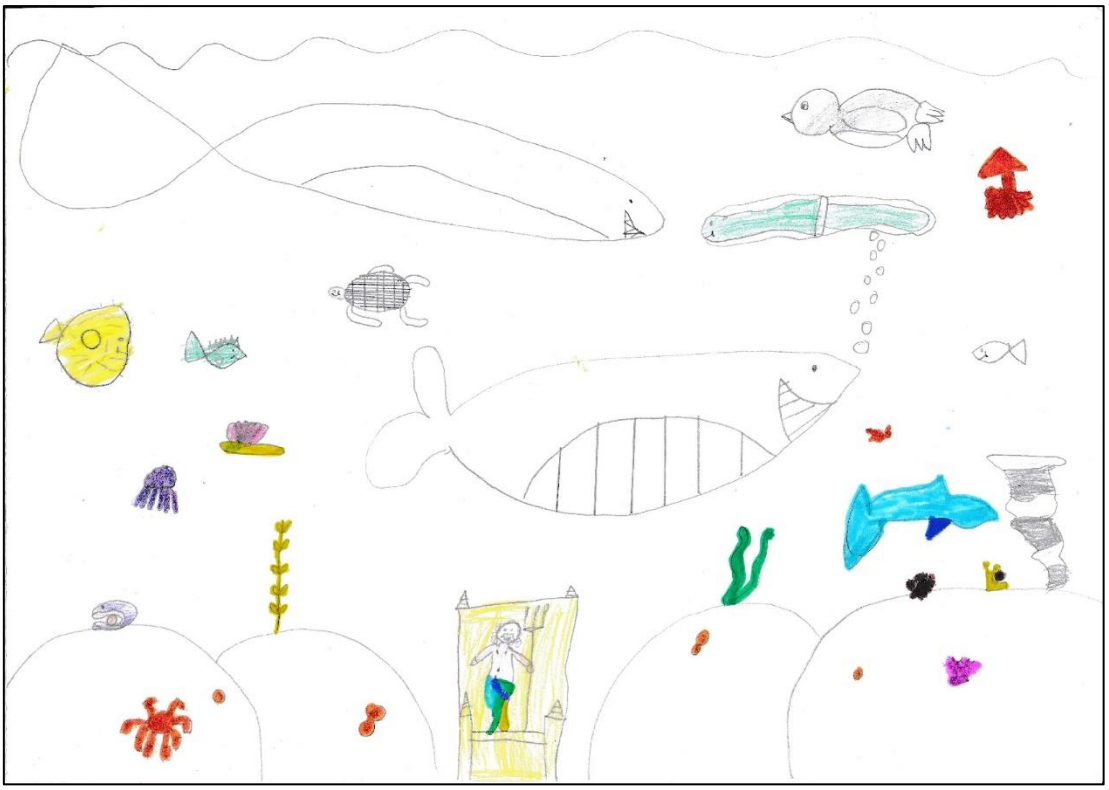

Figure 13: Drawing of a boy from recent urban area (1st visit) focusing on mythical elements - mermaids, castles and forks.

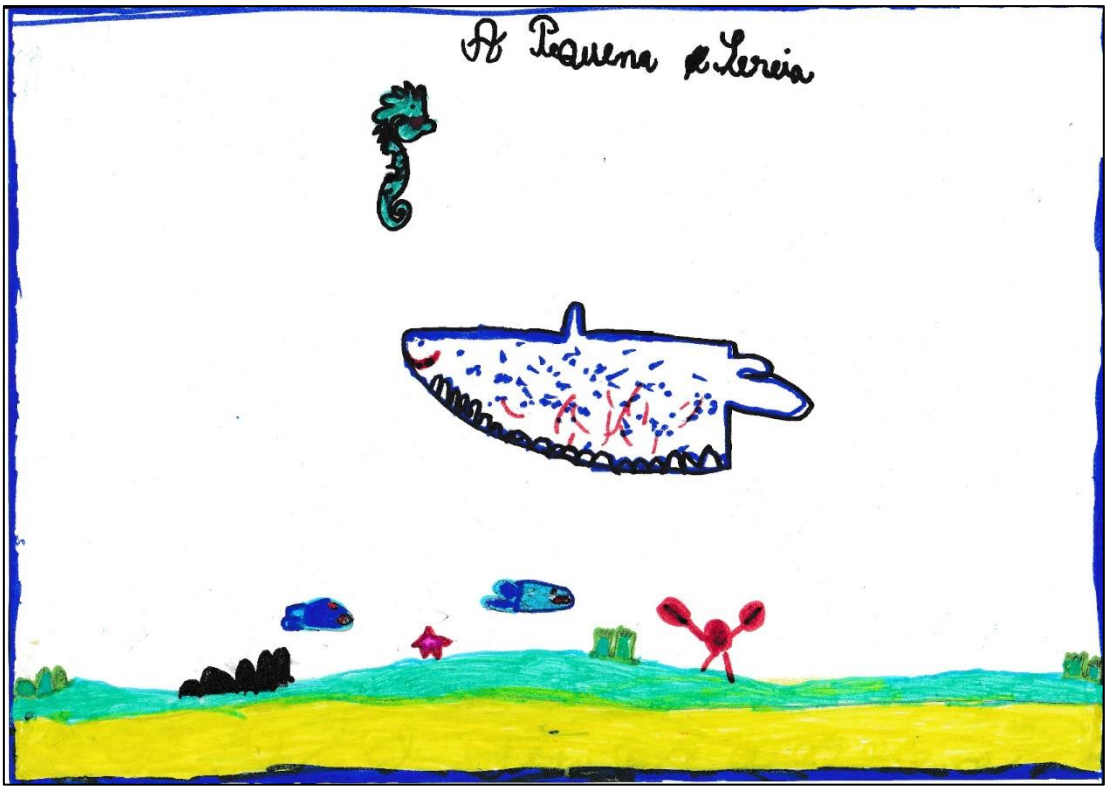

Figure 14: Drawing of a young girl from countryside (1st visit) showing writing related to mythical elements associated with children's movies.

Figure 15: Drawing of a girl from countryside (1st visit) where there are non-marine animals - crocodiles and goats.

Figure 16: Drawing of a girl from countryside (1st visit) where there are animals not belonging to the marine environment, namely hippopotamus and platypus.

Figure 17: Drawing of a boy from countryside (1st visit) where fishing elements are present, revealing previous knowledge about the topic.

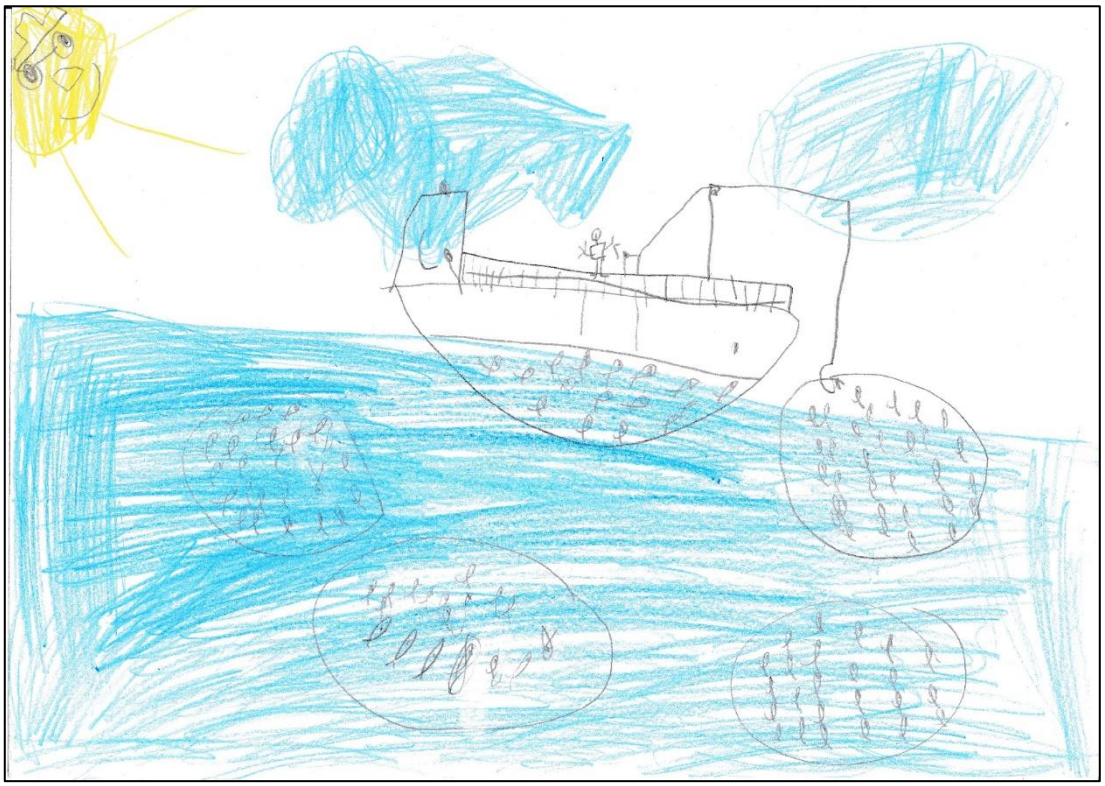

Figure 18: Drawing of a boy from countryside (2nd visit) that focuses only on fishing, with many shoals, fishing nets and fishermen, showing previous knowledge of the subject.

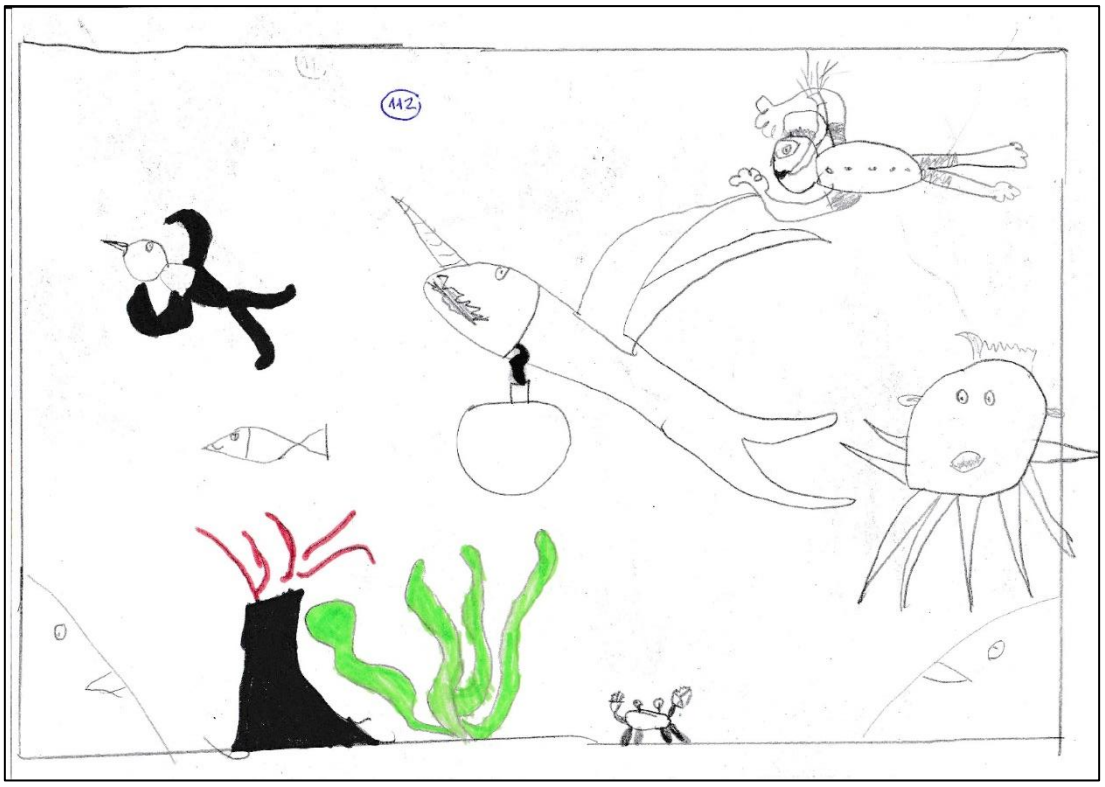

Figure 19: Drawing of a boy from old urban area (1st visit) that portrays unusual elements among the students (seamounts).

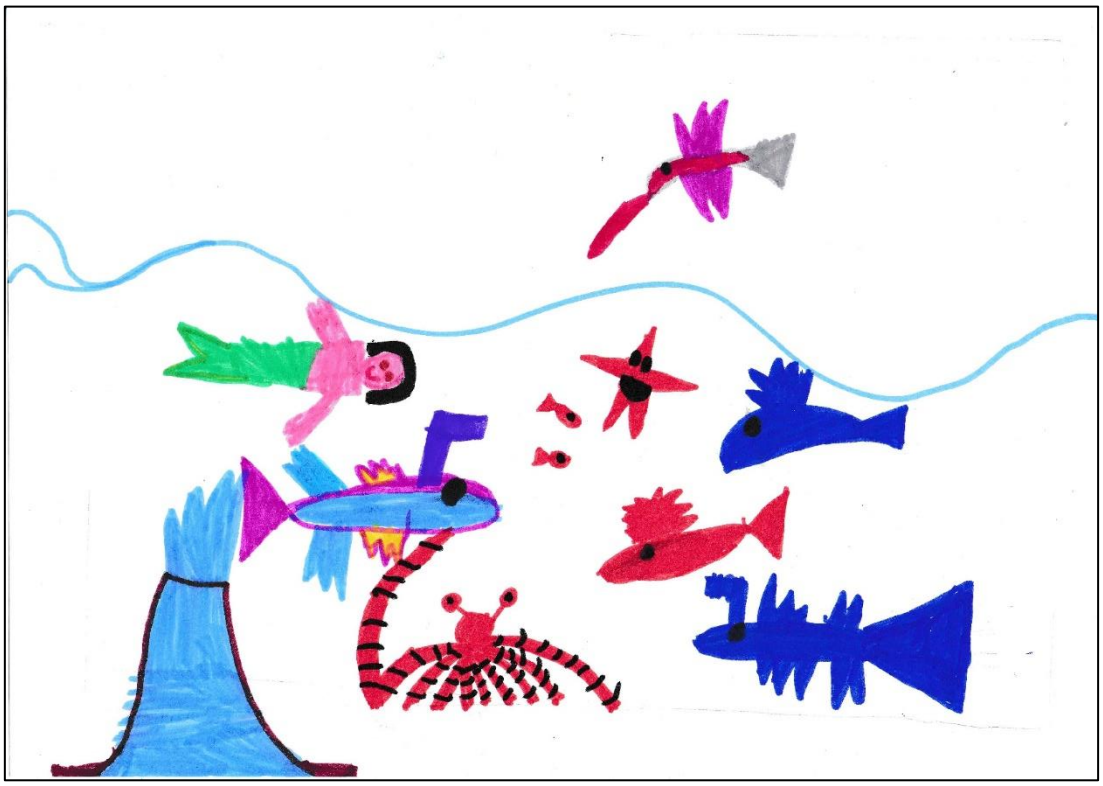

Figure 20: Drawing of a girl from old urban area (1st visit) that reveals unusual elements among the students (seamounts).

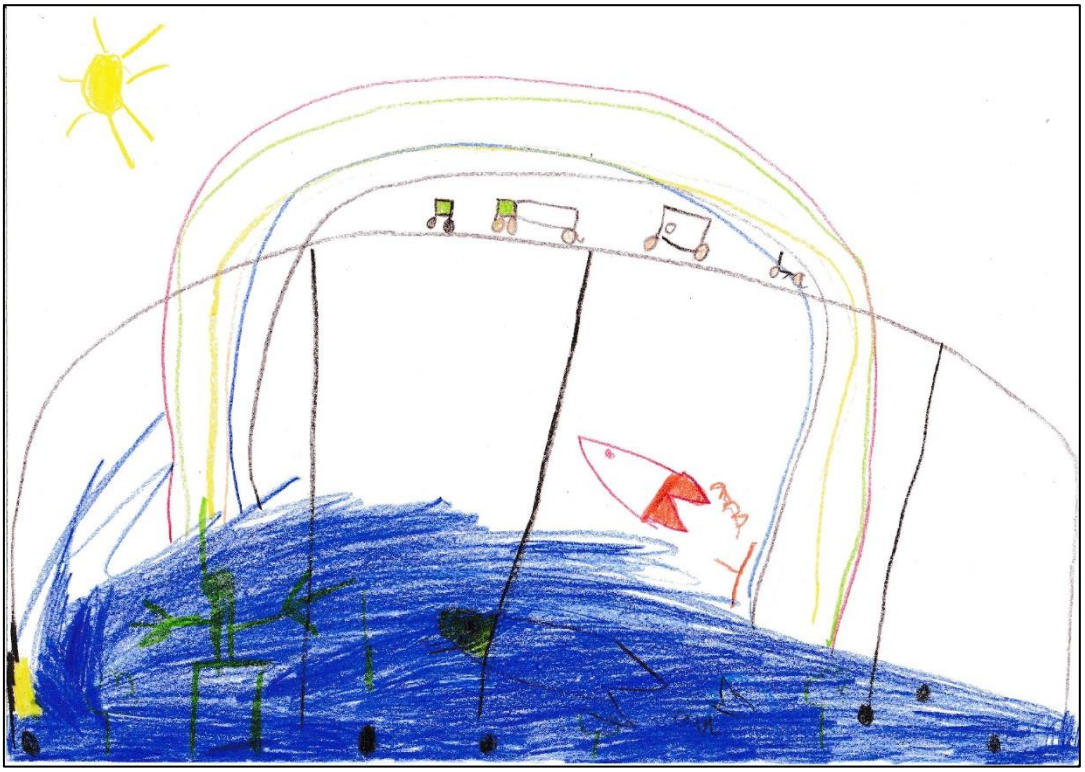

Figure 21: Drawing of a boy from recent urban area (1st visit) that shows elements of human construction - bridges and cars.

Figure 22: Drawing of a boy from recent urban area (1st visit) that shows elements of human construction - bridges, cars, boats and surfboards.

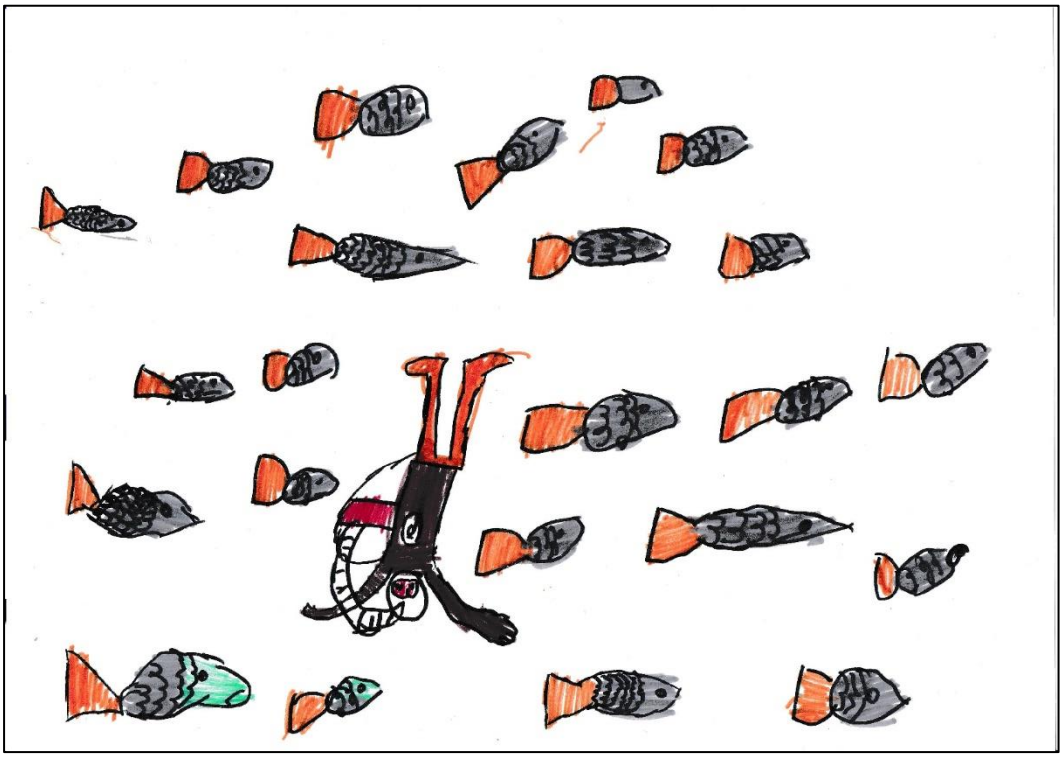

Figure 23: Drawing of a boy from recent urban are, from the group of classes that received the training session (2nd visit) whose illustration is a copy of one of the slides from the PowerPoint presentation related the impact of the Man in the oceans.

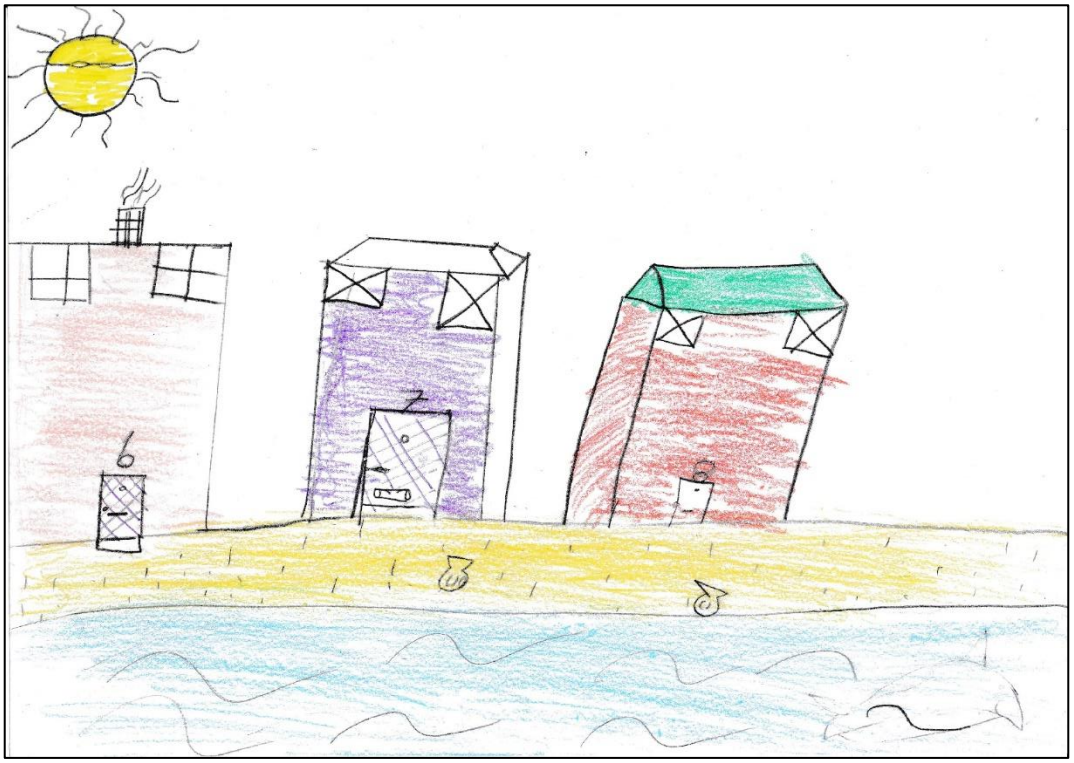

Figure 24: Drawing of a girl from recent urban area, from the classroom that assisted the training session (2nd visit) focusing on one of the themes introduced - coastal urbanization.

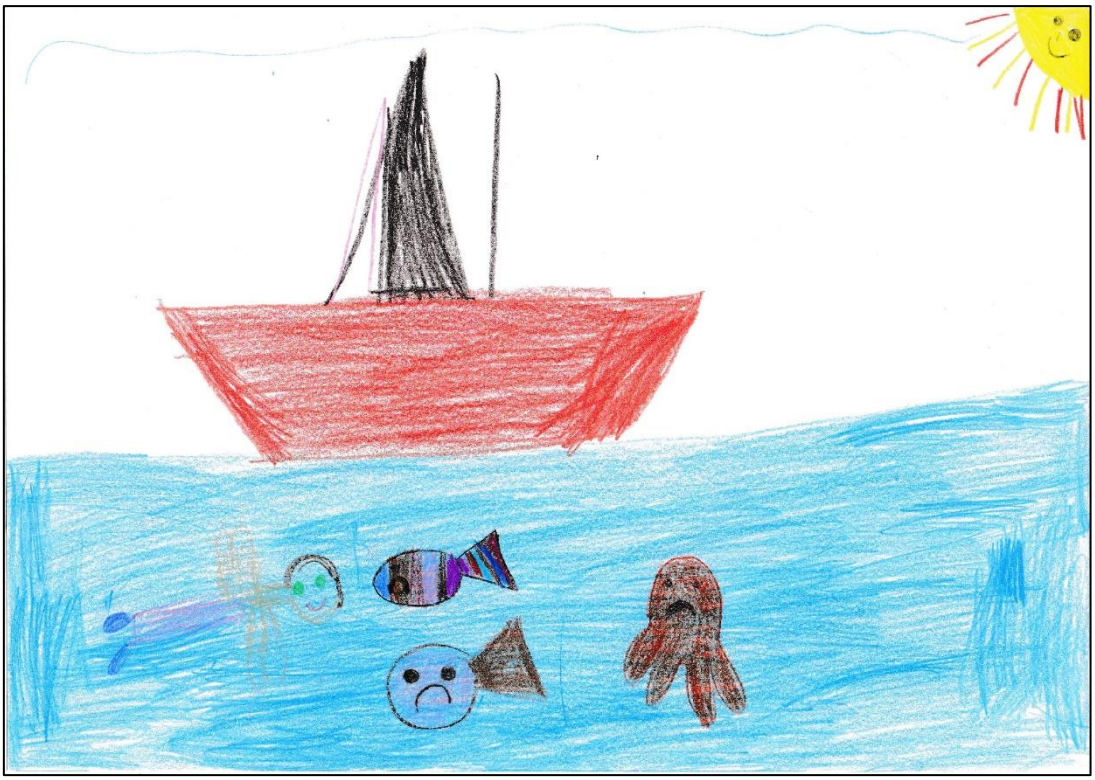

Figure 25: Drawing of a girl from recent urban area of the class subject to educational training (2nd visit) that personifies marine animals with feelings of sadness in contrast to the joy of the human figure.

Figure 26: Drawing of a girl from recent urban area, from the school which attended the educational session (2nd visit) focusing on the issue of pollution from land and sea.

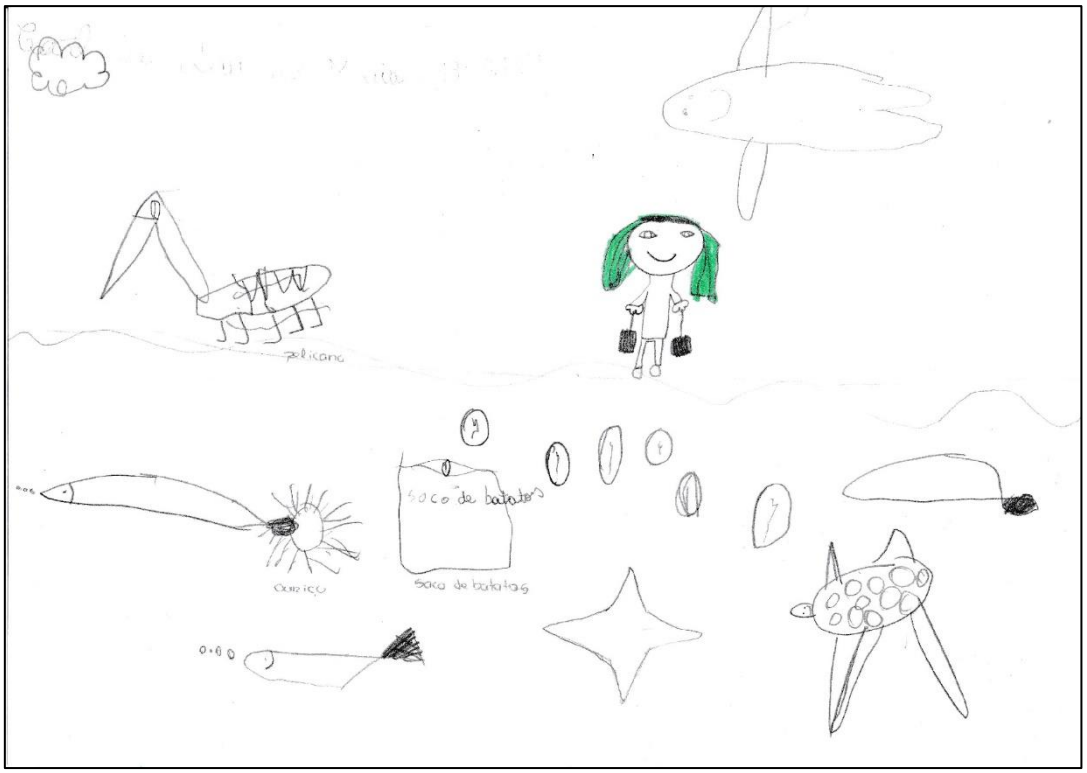

Figure 27: Drawing of a girl from recent urban area, from the school that attended the educational session (2nd visit) that deals with the subject of pollution, with visible impacts for the animals.

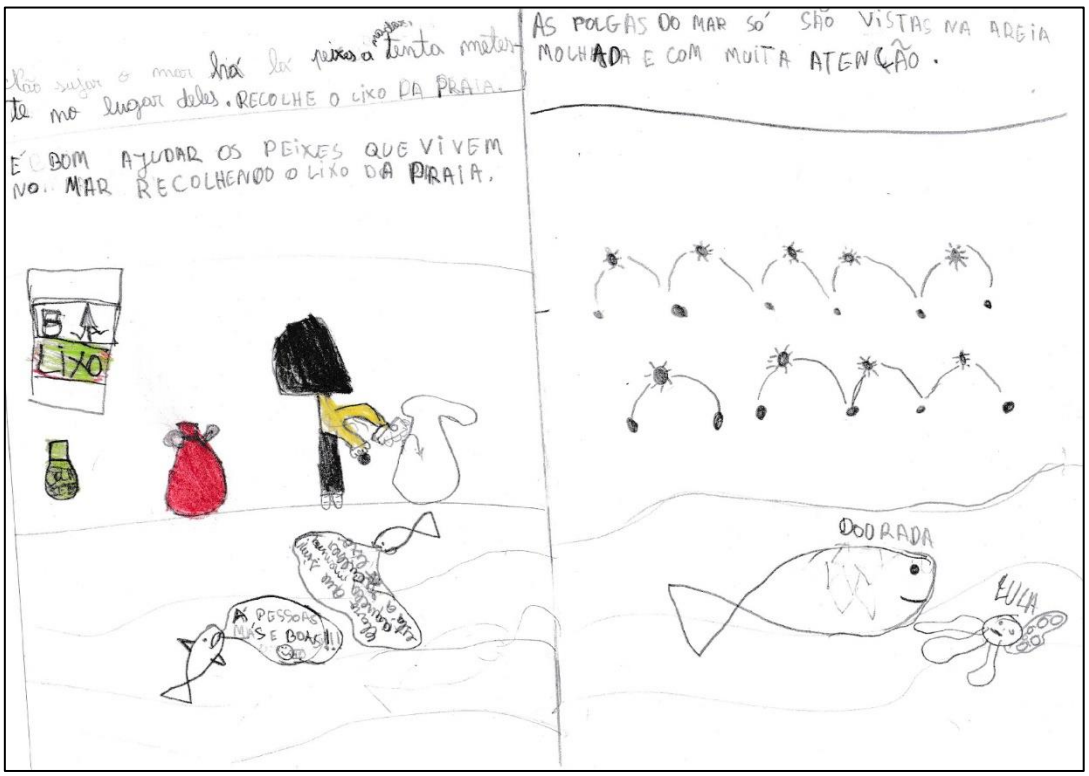

Figure 28: Drawing of a girl from old urban area, from the group where the educational training took place (2nd visit) with pollution awareness messages and descriptions of the animal characteristics.

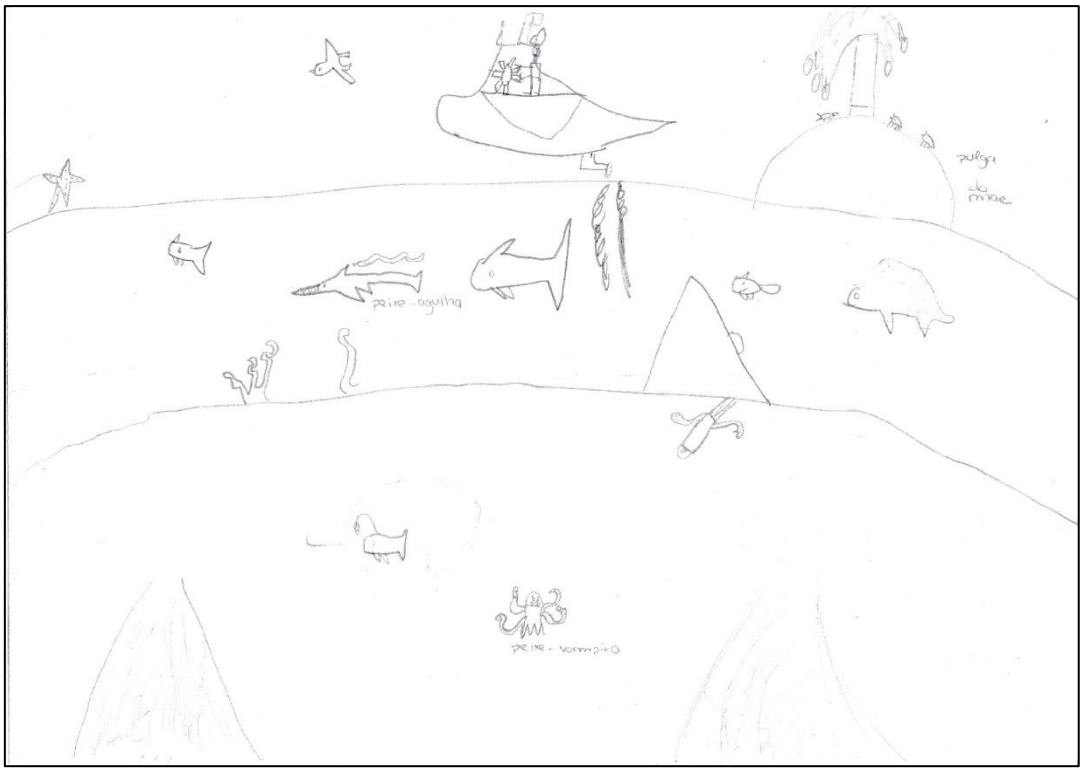

Figure 29: Drawing of a boy from recent urban area, from the group that received training (2nd visit) where can be observed the zonation of the marine environment and its characteristic species.

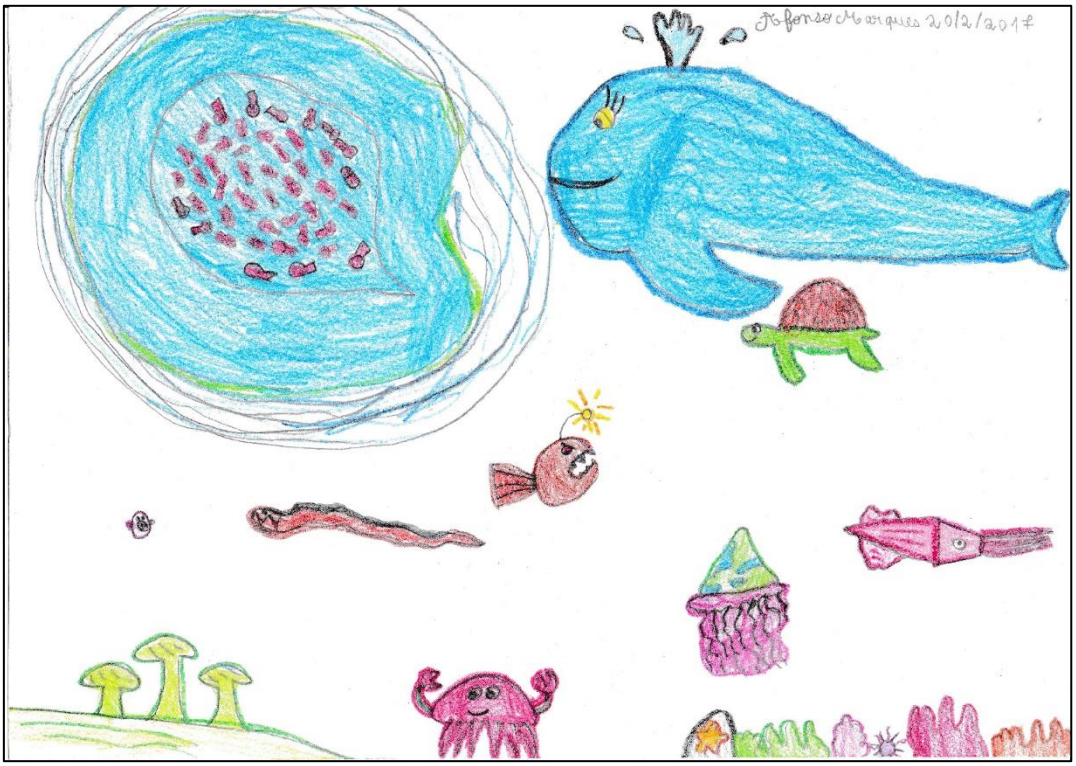

Figure 30: Drawing of a boy from countryside, from the class submitted to the educational session (2nd visit) where there are fish schools, deep sea creatures and coral reefs.